JANUARY 2, 1886.

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

1876---1886.

Just ten years to-day since ENGINEERING NEWS was issued as a weekly! A weakly stripling it was, with but very little of the sources of strength necessary to vigorous newspaper existence—subscribers and advertisers. It has, nevertheless, weathered the storms thus far, and enters its second decade a tolerably strong and prosperous journal. The six pages of text have expanded to sixteen, and the two pages of advertisements in an equal ratio. In the time covered we have preserved the best record of engineering events in America that is in existence; the business of contracting has been largely influenced by the publicity of proposals for contract work introduced by us; we have revolutionized our water-works interests, reducing to a fairly complete system the collection of news, data, and statistics thereof, so as to be readily available to all interested parties; in railway building intelligence, less than two papers in the country can show a better record, and in canals, highways, bridges, tunnels, and general engineering and contracting news, there is not a single class journal in America that can at all compare with ENGINEERING NEWS.

We extend to all our friends—and they count up into the thousands—a hearty New Year's greeting and a sincere hope that they will all meet with us for many anniversaries of the day. We believe that we are on the threshold of a prosperous business term, for how many or how few, years we cannot even conjecture, but while it lasts we feel certain that the engineers and contractors of America will enjoy a large measure of the general benefits. No classes of men deserve the substantialities of life more than these named. They are the improvers of this great globe on which "we live, and move and have our being;" their talents and labor are given to bettering the conditions of life everywhere; and it is to them that much of the genuine comfort of living is due. They tear down only to rebuild to better advantage; they are producers in an eminent degree. All honor then to the many engineers and their executive coadjutors who in a short half century have so materially assisted in bringing this fair Continent to its present advanced position among the foremost countries of the globe.

The most enterprising body of civil engineers and contractors in the world can well afford to sustain the best journal that can be produced, to advocate their interests, collect news specially for them, and post them promptly on the latest improvements in engineering construction. It is our belief in this statement that encourages us to persevere in the programme we laid out years ago. We need only point to the development of ten years past, to convince our readers of the earnestness of our intentions to produce an engineering journal which will acknowledge no superior the world over. We will make a greater advance this year than ever before and we feel quite certain that not one of our subscribers will have reason to regret his investment.

A thoroughly efficient journal, no matter of what class, demands an expensive organization to keep it up to standard excellence. Ten years ago, the writer and one assistant with four compositors, were all-sufficient to take care of each week's issue. To-day, there are fully twenty-five people on our salary list, and specially prepared articles, desirable for our columns, are reasonably certain to find us a purchaser. Our schemes of improvement are limited only by the expense. It is then a necessity in attaining to a high grade engineering journal that it be liberally supported by the classes to whom it is specially addressed. Where clubs of ten to thirty or forty engineers read the single exchange copy that goes to their association reading room, and when all the contractors of a town or small city read the copy taken by the city engineer, whose assistants also read it, there is not much of a margin of encouragement for the publisher. We know such cases to actually exist. The actual circulation in such cases is not a correct index to the advertisers who get the benefit of a very much greater *reading* circulation.

We hope the volumes of this year will correct this state of things to some extent. The one series of papers on Municipal Engineering we expect will prove of such interest, that engineers will want to own them, and hence become subscribers instead of poachers on others liberality. We urge also on our subscribers the loss to themselves by lending their papers. If there were no subscribers there would be no paper, and the more subscribers the more advertisers, and the better the journal itself. We hope to have the earnest co-operation of our present subscribers in increasing their numbers this year.

We have been so fully engaged in the work of the past few weeks, that we have much yet to do. In a couple of weeks we will get into full working trim, and if there are any impatient and dissatisfied advertisers or subscribers we must ask them to possess their souls in patience a while longer.

Irrigation Ditches in the U. S.

According to the report of the tenth Census of the U. S. there are at present 10,000 miles of ditches used for mining and manufacturing purposes in the U. S., which with their flumes, pipe-lines, reservoirs, etc., represent an investment of $27,000,000, exclusive of purchase of water right.

State or Territory.	Number of ditch lines.	Total length incl. flumes.	No. of reservoirs.	Length of flumes.	Length of pipes.
		Miles.		Feet.	Feet.
Alabama	1	1	—	600	—
Arizona	3	19	1	637	85,680
California	65	1707	83	387,248	152,700
Colorado	8	58.75	3	8,424	600
Dakota	6	61.75	5	145,360	2,000
Georgia	8	140.25	7	12,490	20,660
Idaho	17	286	11	29,487	876
Montana	11	160.50	9	42,628	1,700
Oregon	56	615.25	54	89,047	2,460
Total	175	3949.50	173	715,921	266,816

California contains by far the most extensive system of artificial water channels in the U. S., including ⅝ of the total length of ditch lines in the whole country. The relative importance of the California ditch lines is, however, inadequately represented by the mere standard of length; their other dimensions, capacity, more costly construction and economic bearing placing them still higher in rank. Since the beginning of hydraulic mining an immense amount of ditching has been done. 1,000 miles of now idle and useless ditches were built in camps, now long since deserted, and in localities where placer mining is still profitably prosecuted, are also many idle ditches, which have been supplanted by new and larger ones with higher grades. In Boise Basin, Idaho, it is estimated there are no less than 800 miles of old abandoned ditch lines, costing $85,000, and more than double the length of those now in operation. Many such cases exist in California also. Some idea of the magnitude of the water interest in the U. S. may be gained from the following exhibit:

Total length of ditch lines,	miles	10,783	
" " " ditches proper,	"	10,183	
" " " flumes	"	450	
" " " pipes	"	150	
Greatest length of miles under one ownership	"	290	
Average length of California ditch lines	"	12.5	
Maximum capacity of ditch lines, ...gls. per 24 hrs.		7,560	mills
Total cost of plant, including reservoirs, etc., and exclusive of cost of water-rights,		$27,056,942.11	
Average cost of mile, including reservoirs of lines reported		$3,800 00	
Average cost of one mile of all lines		$2,509.22	
Highest cost of plant reported under one ownership		$2,100,000	
Nominal capital stock of thirteen corporations, exclusive of mining companies, owning ditches		$38,805,000	
Working capital of twenty-seven lines		$1,451,300.00	
Total annual expense of maintenance,		$827,260.41	
Annual cost of repairs		$200,288.66	
Annual cost of operation, exclusive of repairs		$626,901.75	
Average length of season of lines reported			211 days

The New York District Railway.

The New York District Railway Company has just been organized under laws of the State of New York to construct a system of subway railways in the City of New York. According to the proposed plan it will run from Bowling Green up Broadway to Madison Square where it will fork, one branch passing up Broadway to the west side of Ninth avenue and stopping there for the present, while the other branch, or the east division, will go by way of Madison avenue to and under the Harlem river to Mott Haven, at which latter point it will afford ready access to about all of the steam railway lines diverging from the city.

Plate I shows a cross-section of the proposed subway; the end aimed at in this design being a roadway with four tracks of standard gauge—two inside for express or through trains, and the two outer lines of rails for way traffic;—continuous galleries on either side for water, gas, steam and pneumatic pipes, all electric cables and wires now in the street, and a provision for the sewers on the line; the entire structure to be confined to the space between the curblines, so that the existing private rights in vaults, etc., under the sidewalks, will not be disturbed.

The method of construction is further described as follows: Street excavation effected in sections, the length of which will be governed by the demands of traffic, a moveable bridge being used to maintain such traffic unobstructed. In the typical cross-section, Plate I, the base of the roadway is a bed of concrete about 2 feet thick, covered with Trinidad asphalte; upon this on a line with the present curbs will be erected a stout external vault-wall (B), leaving the entire area under the side walks undisturbed. This wall will be fitted with suitable openings for all house connections with water, gas, electric, steam or sewerage systems, with the pipe galleries C, D. Access to these pipe-galleries are provided at stations and termini; they will be abundantly large, so that all workmen required can have access to the fixtures for repairs or extensions.

The street roadway will be supported on wrought-iron posts (E E.) and cross-girders (I I), as shown; the posts resting on a continuous granite base, and being 4 feet apart longitudinally. To deaden the noise, and for purposes of general safety to passengers, the spaces between these iron posts are to be filled by panels composed of a net-work of steel wires interlaced with flax or vegetable fibre and an oil compound, and the whole pressed into a solid panel by hydraulic pressure. These continuous longitudinal partition walls will answer an excellent purpose in the better ventilation of the subway besides deadening the noise that would certainly follow the rapid passage of railway trains between metallic walls. The buckle-plates resting on the cross-girders are to be of steel, and they will be covered by about 2 inches of Trinidad asphalte, as a protection against chemical contact and dampness, and then by 6 inches of concrete, which will in turn support the street-paving.

Electric power is to be depended upon as a motor for trains; and, as the cars will approximate closely in section to the tunnel area in each sub-division, it is expected that when in rapid motion they will act as loose pistons and establish an efficient ventilating current.

The excavation required for the railway is 35 feet wide by 16 feet deep, and the pipe-galleries will require an additional width on either side of 4 feet 6 inches by 16 feet deep. The nearest rail to existing buildings is 24½ feet, and the excavation is above the "thrust-line" of the shallowest foundations on the route. The cars themselves will also be made of the same "Ferflax," or steel wire and fibre compound described for use in the partition-walls, bolted upon strong steel frames. Cars so constructed can not break to pieces under any conceivable usage, nor can they leave the rail under the intended arrangements.

Plates II and III show the general design for stations; the first providing for a widening of the road-bed at such points and access from above to all or any track. The second shows a plan proposed where the narrowness of the streets will not permit such a disposition of the rails; here the express trains are taken through on the regular grade while the side tracks are depressed at stations so that passengers enter on a different level.

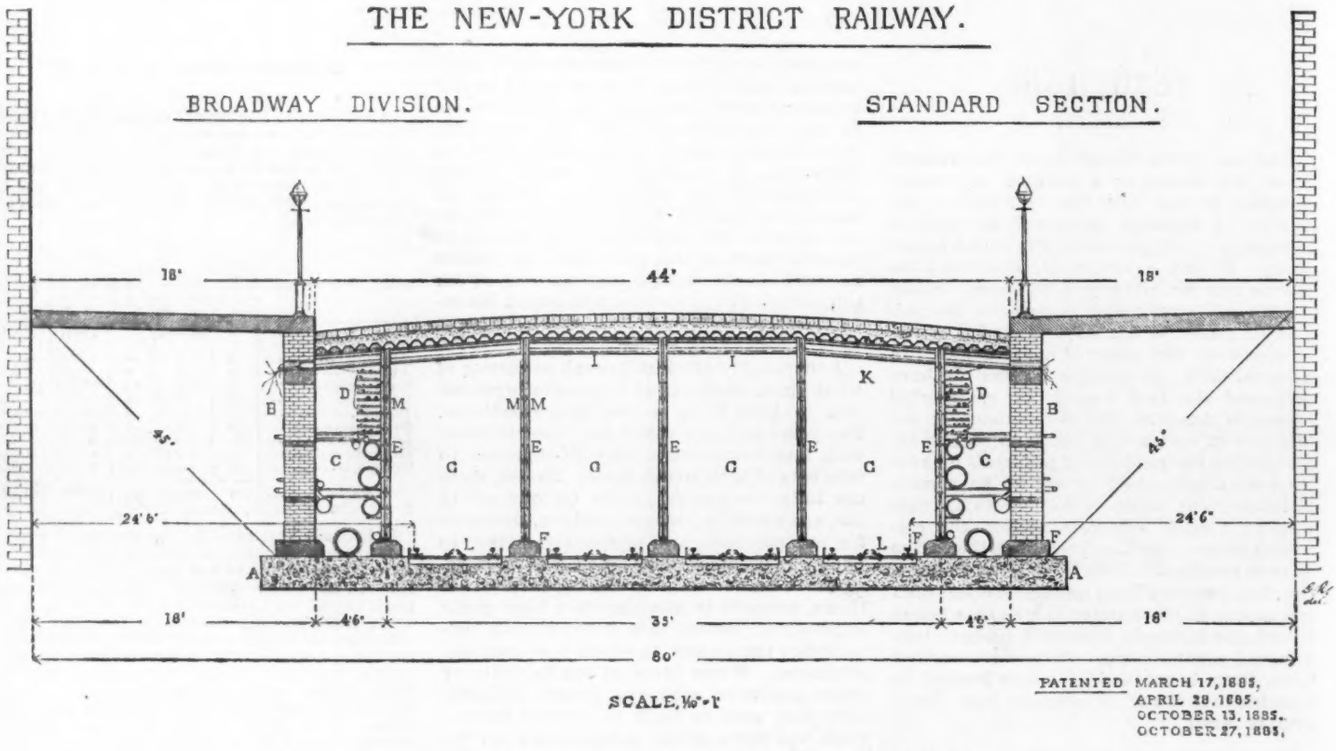


Plate I.—N. Y. District Railway; General Cross-Section.

Plate IV is an enlarged view of the pipe galleries. In this arrangement the electric-lighting wires are placed so as to pass just under the steel buckle-plates, as far removed as possible from the other electric wires which occupy the upper division. In the centre space is carried the steam heating pipe encased and packed as shown, and under this is the gas-main. Water-pipes and a sewer-pipe are shown in the lowermost division. As the base of the outer partition-wall of the roadway is a continuous line of granite blocks of considerable height it forms with the base of the vault-wall an open channel-way to carry off water or sewage in case of any break in the mains until such breaks are repaired.

These plans have been examined and pronounced correct in theory and as having a great excess of strength by the following well-known engineers among others:—Messrs. C. C. Martin, Alfred P. Boller and A. Bonzano. Builders of experience also certify that they can see no danger to the stability of buildings on the street while the road is under construction.

The following is a list of the Directors:—Chas. Spear, S. B. Eaton, J. Coleman Drayton, R. W. Stevenson, Wm. A. Street, J. Ogden

Hoffman, Adolp Ladenburg, G. Renault, Jos. Low Blackwell, David Paton, W. Barclay Parsons, Jr., L. W. Winchester and Geo. B. Post. In addition to these names the following gentlemen appear among the incorporators:—Wm. Post, Geo. P. Slade, Newton S. Finney, Edward P. Beach, Oliver K. King, Sir Roderic W. Cameron, C. Francis Bates, John H. Davis, Calvin Goddard, M. W. Cooper, Geo. F. Seward and Victor E. Burke. W. Barclay Parsons, Jr., is the engineer-in-charge.

The estimate of cost has not been made public in its details; but a sum of $3,000,000 per mile is figured as sufficient to cover all expenses, including the entire renewal of the water, gas and sewerage systems effected and an entirely new street pavement and the dumping into the Bay of all refuse excavation. This sum is considered, however, as a maximum hardly to be reached, for it does not allow for a return from old material that is marketable and the fact that much if not all of the earth excavated can be sold again for filling purposes.

Plate II.—N. Y. District Railway; Station on a broad street.

The Forced Draught and Boiler Economy.

Written for ENGINEERING NEWS.

BY CHAS. W. BAKER, UNIVERSITY OF VERMONT.

Two score years ago, the maximum of economy in steam engineering was the Cornish boiler and pumping engine; a type of machinery which, from its massiveness and slow movement, was more akin to the spirit of the eighteenth than the nineteenth century. It is true, indeed, that the designers of these machines, working on the time honored maxim that "haste makes waste," achieved an economy in fuel consumption not often reached to-day; but they did it with an expenditure of both time and money, that brings the balance far down on the other side and makes the whole an example of wastefulness instead of economy. It must not be thought, however, that these early engineers had no principle of guidance more scientific than the old saw above referred to. They understood well the theoretical requirements for a high evaporative duty, and in the construction of these Cornish furnaces and boilers, probably stated them about as follows: 1. Admit no more air to the furnace than is necessary. 2. Secure complete combustion by a hot furnace. 3. Extract as much heat as possible from the gases of combustion. 4. Protect boiler and furnace from external radiation. The first of these essentials they obtained by throttling the air supply with numerous dampers; the second, by making the furnace of firebrick; the third by a slow movement of the products of combustion, which the limited air supply and large area of heating surface combined to bring about; finally they secured the fourth by giving to boiler and furnace a thick jacket of brick.

There is an old and wise proverb which states a general principle by means of the pithy assertion that, "there are more ways than one to kill a cat." The application of this in the present case is, that while the theoretical requirements of these early designers were faultless and their means of securing them effectual, yet other means of securing them may be more effectual and far better suited to the practice of the present day. Now in mechanics as in morals, it is always productive of error when people confuse means and ends, as the majority of mankind are prone to do. Thus, because the requirements for boiler efficiency are the same now as forty years ago, many steam users think that a high efficiency cannot be attained except by the methods in vogue at that time. They suppose economy to vary inversely with the rate of combustion upon the grate, that the best way to save coal is to invest their money in unlimited heating surface, and that anything in the shape of a blower or blast pipe is as contrary to fuel economy as vice is to virtue. A good example of this prevalent opinion was recently expressed by an unscientific friend of mine, to whom I explained the working of the locomotive blast nozzle and the intense combustion secured thereby. "Why," said he, "I should'nt think they could utilize more than a hundredth part of the heat."

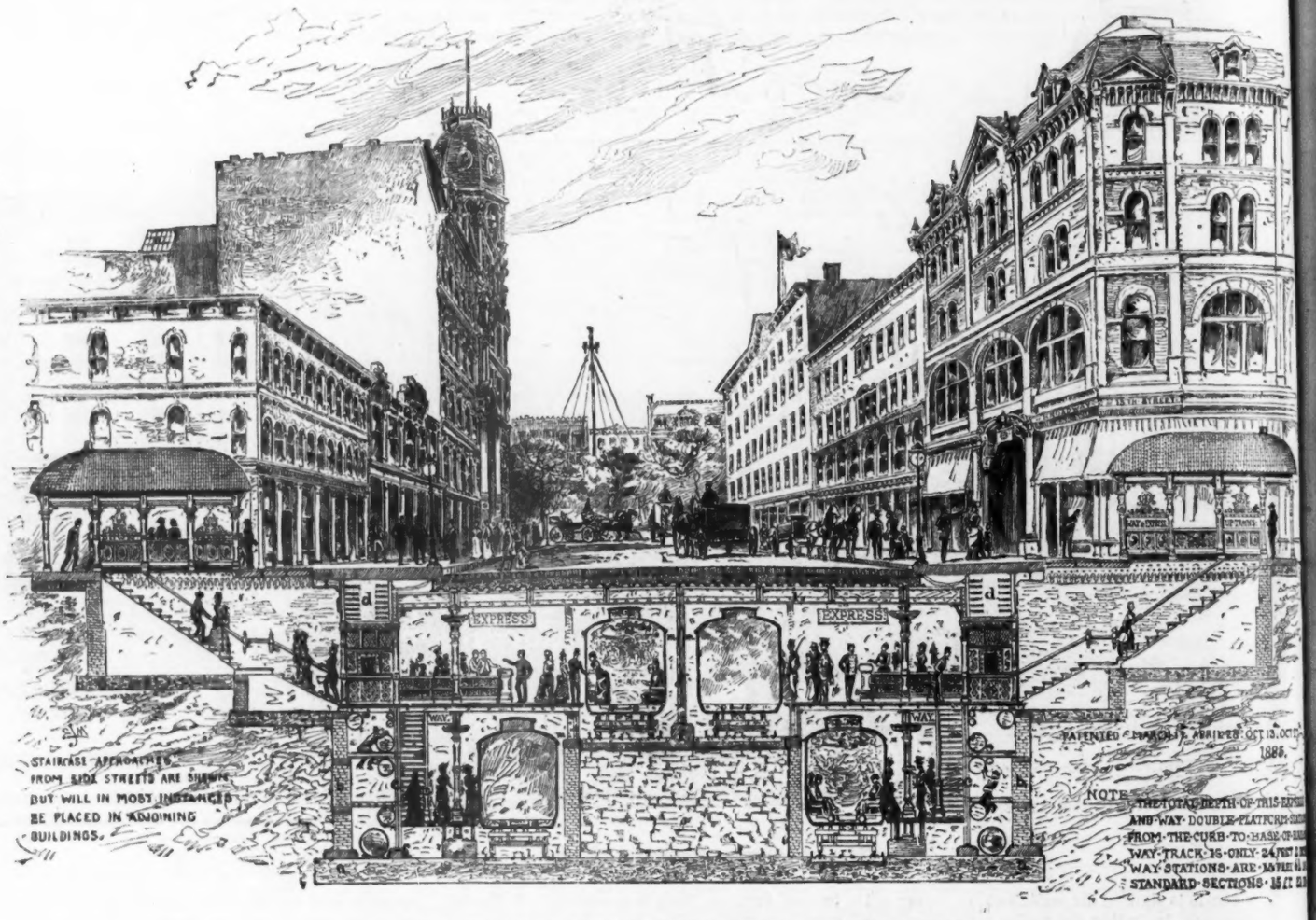
However valuable public opinion may be in politics, it is a factor of little worth in determining scientific truths; and in our study of the merits and demerits of the forced draught, we must not be biased in our judgments by the fact that people in general (and, I had almost said, engineers in general) know little about it, care less, and consider it, if they consider it at all, of small importance and value.

In studying the forced draught, let us see first to what extent and with what success it is in use; and then see in what ways it is theoretically efficient. As we turn to the practical side of the question, we are met at the outset by one acknowledged fact. Since the time when a fortunate inventor turned the exhaust pipe of the locomotive into its smokestack and found that he had thus quadrupled

the strength of his iron steed, it has been pretty well understood that where compactness and lightness were necessities, the forced draught was a valuable means of attaining them. Indeed, it is not too much to say that without this agent the great railroad system of the present day would have been an utter impossibility. But, while it is generally known that the locomotive boiler gives us great power in a small space, few believe that it is an economical generator of steam, and most people, as already said, suppose it to be exceedingly wasteful. Even Forney, in his "Catechism of the Locomotive," says: "So rapid is the movement of the products of combustion, (in locomotives) that a smaller proportion of the heat is imparted to the water contained in the boiler, and consequently a less amount of water is evaporated in proportion to any given amount of fuel, than in boilers in which combustion is less violent." That this should be the case seems not improbable, when we compare the conditions of working in the average locomotive boiler with those that obtain in the average factory boiler. The gases of combustion pass into the smoke-stack of the former at a temperature higher by two hundred degrees than in the chimney of the latter. The factory boiler generates a reasonably constant amount of steam during working hours. The locomotive stops here two minutes, there fifteen; now fire, boiler, and engine are pushed to their utmost in ascending a steep grade, and then the train descends an incline by its own momentum. Again a heavy brick wall surrounds the stationary boiler and about this is the atmosphere of a hot boiler room. Part of the locomotive boiler is covered with a thin lagging, and it is exposed to cold, wind, rain and snow. Add to this the facts that the locomotive boiler carries a considerably higher pressure than the other and loses more or less solid fuel through the violence of the blast, and it will be readily perceived how good grounds one has for doubting its efficiency. But, notwithstanding all this, while it may not be possible for the locomotive boiler hampered by these circumstances to make as high a record as has been attained by stationary boilers in competitive tests, I do claim that the evaporative efficiency of the average locomotive boiler is probably equal to that of the average stationary or marine boiler; and, further, that it is the forced draught whose effect neutralizes the above unfavorable conditions and makes the locomotive boiler an economical generator of steam. How and why it does this, I will endeavor to show later on.

Leaving now the locomotive, we find that the forced draught has been tested to some extent in marine engineering, especially in the equipment of the torpedo boats. Although other reasons than economy have caused its introduction, and few tests of its effect on fuel consumption have been made, I believe that it has been found to be generally very economical.

Having seen then the record of the forced draught in practice, let us see what the books say about it. Do not look for it in the indexes, however; you will not find it there, nor will you find a chapter, page or section concerning it. Perchance, however, you may find some casual allusion to the effect that, "A slow combustion is found by experiment to give the best results as regards economy of fuel;" or notice some unconscious expression that tells us that the author had never thought it worth while to examine the effect of draught intensity and consequently shared the common belief concerning it. Recent writers, however, have evidently heard of such a thing as the substitution of a fan for a chimney; but, while they concede its advantage in "keeping dimensions within moderate limits," they have little to say of its effect on economy and seem to consider it about neutral. In short, few, if any, prominent engineers have as yet declared the forced draught to be a great benefit in the attainment of higher efficiency.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STAIRCASE APPROACHES FROM SIDE STREETS ARE SHOWN BUT WILL IN MOST INSTANCES BE PLACED IN ADJOINING BUILDINGS.
PATENTED MARCH 3, ABRIDGED OCT 13, OCT 1885.
NOTE

Plate III.—N. Y. District Railway; Station on narrow street.

Failing, thus, to find positive statements or theories, let us theorize for ourselves. Let us see what the requirements are for maximum efficiency in a steam generating plant; and see how each of these requirements may be properly and economically obtained by means of the forced draught.

The first essential we will consider is a complete combustion of the fuel, and this can only be attained by three subordinate conditions; the maintenance of an igniting temperature, a right mixture of air and fuel, time and space, for chemical combination. In all parts of a properly designed forced draught furnace, the temperature is much higher than in the ordinary furnace; and it is impossible for

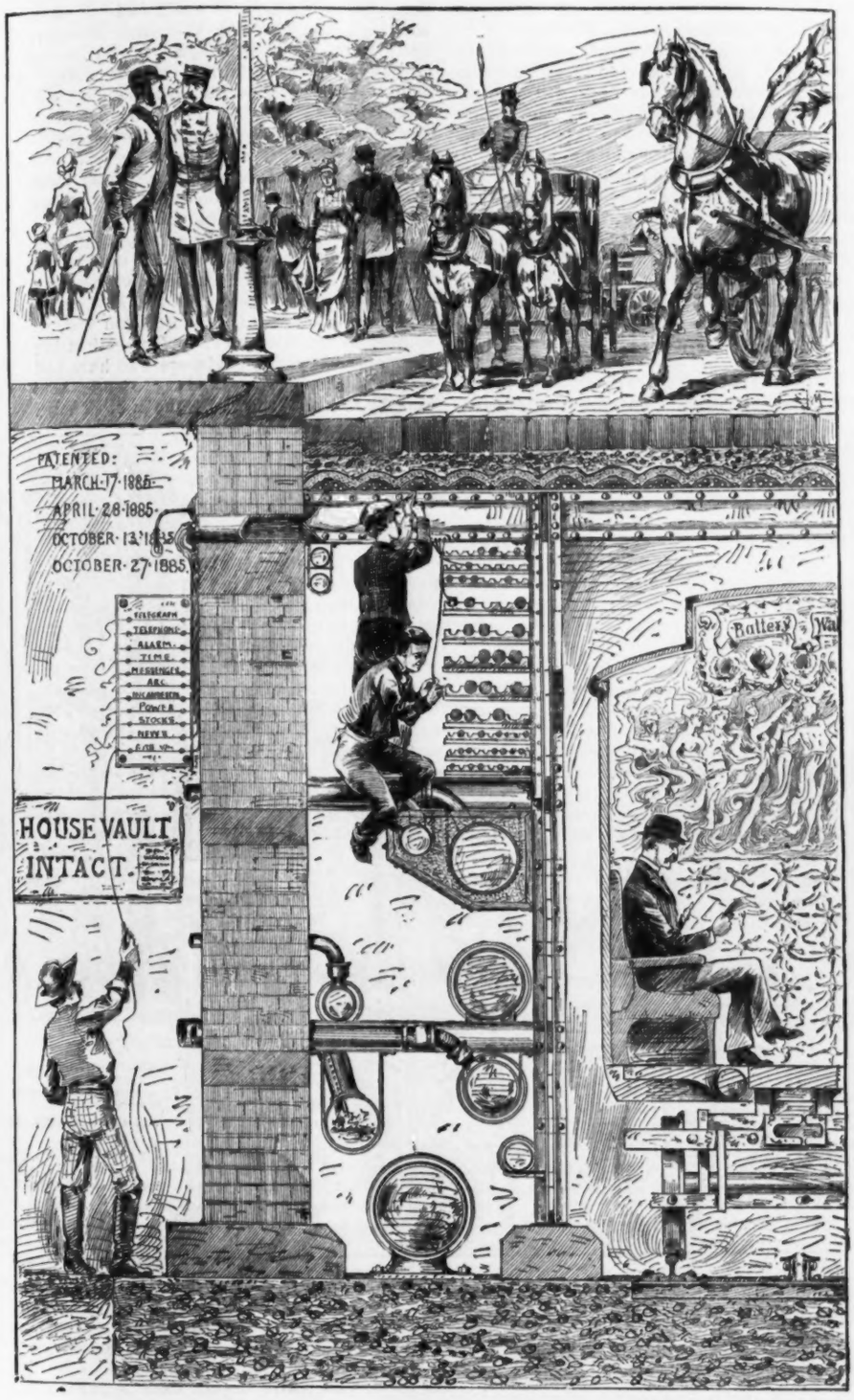


Plate IV.—N. Y. District Railway; Pipe-gallery.

any gas to leave the furnace without having been raised to a temperature sufficient to ignite it. Now supposing a proper supply of air, which it is certainly the work of a forced draught to effect, and it is evident that no fuel can leave the furnace unburnt, if time has been allowed for combination. The opponents of forced draught hold, very naturally, that it does not allow time enough for combustion, before the air and gas are rushed into the tubes and cooled below the igniting temperature. How then can the time ordinarily necessary for combustion be reduced? It is the time necessary for the air and gas to diffuse and unite atom with atom. Hence the thorough mixture of air and fuel will be a long step in lessening the necessary time, and the high temperature of the furnace, causing diffusion and combination to proceed with great rapidity, will give a still further reduction. We may conclude then, that, as regards the combustion of the gaseous part of the fuel, the forced blast does allow sufficient time for combustion; and as for the formation of smoke and carbon monoxide, it is well known that they tend to form under limited air supply, and at a low rather than a high temperature.

The next essential we would consider is minimum excess of air supply. The forced draught secures this essential by means of the high temperature of the furnace. For, suppose bituminous coal to be used, then we have a body of fuel on the grates so highly heated that the amount of combustion depends on the amount of air admitted. We have also a gas constantly generating at a rate proportional to the temperature of the furnace; but as we well know the temperature of the furnace depends on the rate of air supply. Hence as the rate of air supply and gas generation vary together, we may reasonably conclude that the air excess is no greater than in the natural draught, and is probably much less. In corroboration I could quote the opinions of several engineers who give the air excess in the locomotive as half that of the chimney draught.

As the third essential of maximum economy, I would say that the gases of combustion should pass into the chimney at the lowest possible temperature. The Cornwall designers accomplished this, as we have seen, by giving the flue gases plenty of time to transmit their heat to the boiler. In the locomotive it is attained in part by a small diameter of tubes. But in the forced draught in general much better results are possible in this direction, than with the ordinary draught. The temperature of the discharging gases with the latter must not fall too low, or the chimney will not draw. Also, as the strength of the draught is limited and variable, the flue gases cannot be diverted from a direct course beyond a certain point.

In the forced draught, on the contrary, the designer can send the products of combustion through winding and contracted passages in any direction he pleases; can utilize them to heat feed water, air supply, or for whatever else is wished, and finally discharge them at a temperature but little exceeding that of the external air. Now, in fuels containing much hydro-carbon, and in any case from the moisture in the air supply, the flue gases contain a good deal of watery vapor. When the flue gases are cooled to a temperature below 212°, this vapor is condensed, and we save the latent heat contained therein.

Again, where cooling is carried to this extent little pains need be taken to avoid an excess of air supply, and what was named as the second essential becomes no longer necessary. From this it follows that where smoke prevention is desired, the large excess of air which it generally requires will no longer detract from the efficiency of boiler and furnace; and further, smoke being avoided, the heating surface will no longer have its efficiency impaired by the deposition of soot.

The fourth and last essential is that we avoid as far as possible all loss of heat by radiation to the external air. To secure a high furnace temperature and thus the first two essentials which we named, the stationary furnace is generally built of fire brick, and the flues are relied on to make the steam. But while brick is generally a non-conductor, when exposed to the temperature of a boiler furnace, it transmits considerable heat to the outer air. With a forced draught, however, a high temperature may still be maintained, although the walls of the furnace form a part of the boiler, as in the locomotive firebox, and thus the radiation from the combustion chamber, where the heat is most intense, is all utilized.

But an item of much greater importance than this claims our attention. To generate the same amount of steam per hour as that which the locomotive boiler will furnish, would require a battery of from *five* to *twelve* or more ordinary return tubular boilers, of the same size shell as the locomotive boiler, and working with ordinary chimney draught. Now suppose these boilers set in masonry, and

each with its own separate furnace as is usual, and compare the surface exposed to external radiation with that which a locomotive boiler exposes! And, further, compare the expense of clothing them with the protection which a half or third of that expense would give to the single locomotive boiler. It is to this matter of external radiation more than to anything else, that I ascribe the remarkable economy of the locomotive boiler under so many adverse circumstances.

We have thus reviewed the requirements of fuel economy, and have seen how they are met by the forced draught; but we have said little of its efficiency in reducing other items of expense, of its making one square foot of heating or grate surface do the work of ten by the old method, one furnace and boiler do the work of a dozen of the same size; of its doing away with chimneys, whose draught varies with wind and weather, of the perfect control which it gives of the rate of combustion and evaporation. These and other advantages must be considered in comparing the new system with the old.

In view of these things, then, we may well ask why the forced draught is not in more extensive use. I believe it to be because of ignorance of its merits, and a blind adherence to former practice. I very much question, indeed, whether there are many mechanical engineers among us who would risk their reputation by advising forced draught for a proposed stationary boiler plant.

Nevertheless, it is in this direction that progress lies. We have found already in many machines notably the engine piston, that high speed means economy, and the steam boiler is no exception to this rule. It is true, indeed, that it takes more brains to design and manage a plant with forced draught, than with the old appliances. A quick-moving machine always requires better and more exact engineering and workmanship than a slow one.

A grate, burning a hundred pounds to the square foot per hour, will not stand the neglect that a five pound per hour will. An air pressure of a quarter of a pound to the square inch may not be allowed to infringe on the fuel, or strike hot boiler plates haphazard.

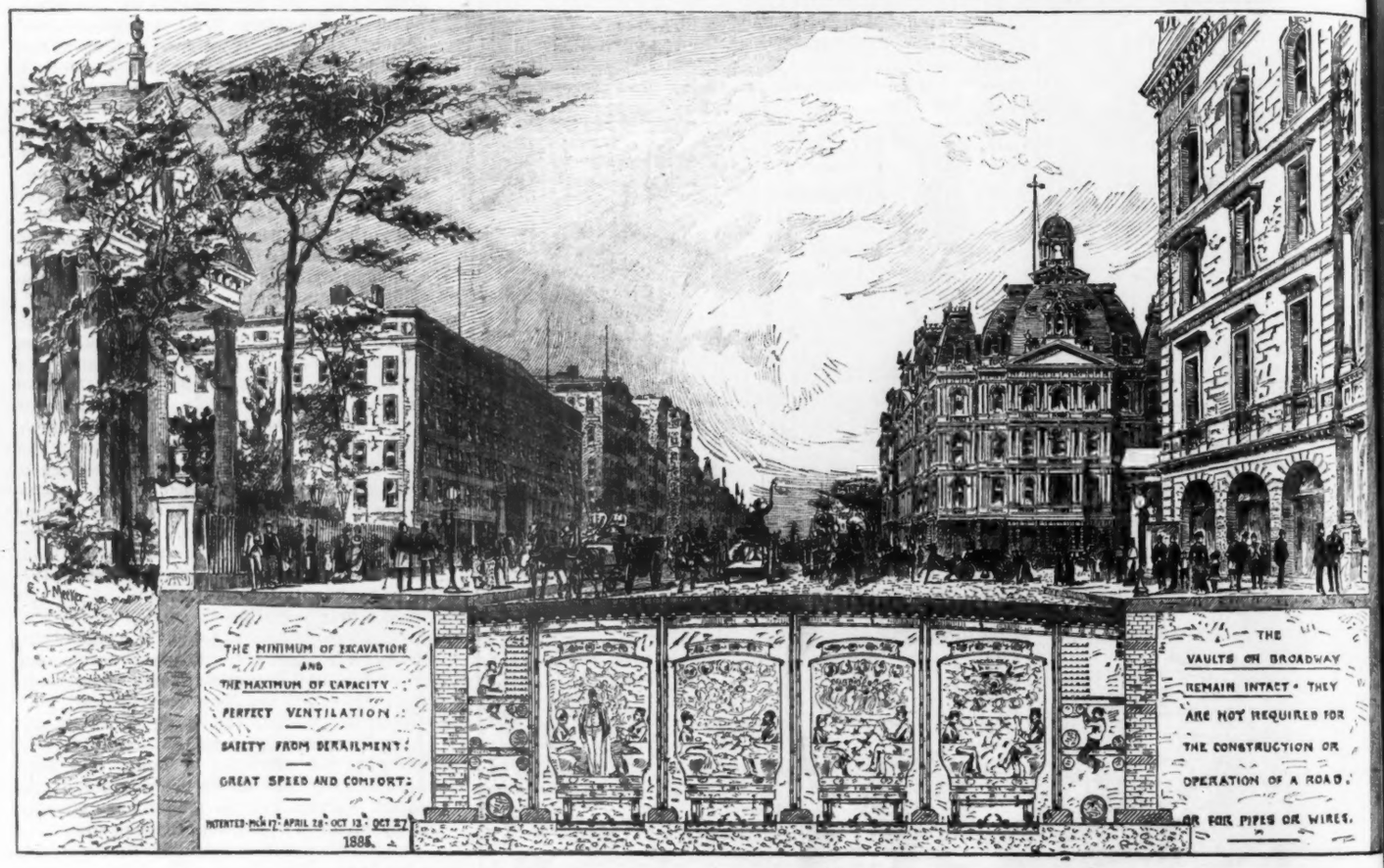
We are burning millions of tons of coal every year in our furnaces, and every move toward economy merits attention. It is time that steam users were informed of the advantages of the forced draught, and that the engineering profession should thoroughly understand the remarkable economy that attends its use.

Concrete *vs.* Brickwork.

During the past few years there has been, and now is, an increasing tendency to substitute, especially in certain classes of construction, brickwork by concrete, and the developement of this practice has been marked by incidents which commonly ensue upon the introduction of a new material, or the extended use of one already known to the engineer, architect, or contractor. Minimum cost, we cannot say economy, is eagerly pursued by constructive mankind, and might, with a good show of reason, be added to the list of extraordinary popular delusions. It naturally results that with this spirit permeating all our transactions, combined with the scarcity of work, competition is so strained that starvation prices are accepted in preference to closing the building yards. Were fair prices obtainable there can be no doubt that good work, as good as that done in years gone by, would be done; but, as matters now stand, this cannot be expected; a contract once secured the contractor must set about to scheme a profit out of it. If there are sub-contractors to be employed then the competition business is again enacted on a smaller scale, but with the same outcome. Fifty years since there was a proverb to the effect that "fools build and wise men buy;" that, however, will not obtain in our day, and especially in the rapidly increasing suburban districts where we see so many new houses to be let *or sold*. In nearly all these cases the door and cupboard panels shrink from their frames, and picture nails may be plucked from the walls with the fingers.

In large engineering works requiring Acts of Parliament, the action of the designer is frequently hampered by a previous assumption of the cost of works for the Parliamentary estimate. An experienced man will, of course, design his works before estimating their cost, but young engineers who have had no practical experience, and try to lead others into the idea they have, by the use, of such set phrases as "looking at the matter practically," frequently make very crude guesses, and subsequently require the engineers to assist them, who really design their works to make the drawings fit their figures.

Here is an illustration. A wet dock is required, and the general dimensions being given, is properly designed with a sufficient lining of brickwork in hydraulic mortar on a bed of good concrete. The estimates having been prepared, are found to be in excess of the Parliamentary estimate. This is not an imaginary case, but one that came under our notice a number of years since. The paring down then commenced. First the brick lining was reduced in thickness, and then altogether dispensed with, leaving at the bottom a quite inadequate thickness of concrete, even assuming it to be properly made and mixed; and the same process was applied to the other parts of the work. The Bill, however, as was anticipated by those employed on the draw-


THE MINIMUM OF EXCAVATION
AND
THE MAXIMUM OF CAPACITY
PERFECT VENTILATION
SAFETY FROM DERAILMENT
GREAT SPEED AND COMFORT
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1885.
THE VAULTS ON BROADWAY REMAIN INTACT. THEY ARE NOT REQUIRED FOR THE CONSTRUCTION OR OPERATION OF A ROAD, OR FOR PIPES OR WIRES.

Plate V.—N. Y. District Railway; General Cross-section at Post Office.

ings, did not long survive its introduction to the Parliamentary Committee.

In view of such proceedings, we have no reason for surprise at the fact that dock-works sometimes break down, and retaining walls fall, or bulge in such a way as to necessitate their being shored up with stout timbers—at all events, until the earth behind them has consolidated.

In the first place, we should consider what are the legitimate uses of concrete and the duties which it is called upon to support, and this will require some remarks of a preliminary character upon foundations. It is a common sense observation that the foundation of any building should be of solid and continuous structure, practically solid throughout in order that neither splitting nor unequal settlement can occur. Much depends upon the nature of the soil upon which the work is to be raised, and this must be ascertained prior to designing the foundation. If the subsoil is fairly uniform, comparatively thin footings may be used, say two layers of sandstone slabs six inches thick laid so as to make a good bed, and jointed with cement, in order to consolidate the whole, so that it will evenly distribute the superincumbent load, and sustain the pressure in any places where the subsoil gives a varied resistance. The materials, however, which are best suited to the purpose may not always be practically available, much depending on locality; thus in Yorkshire, for instance—a stone country—there is no difficulty, but in the south the use of stone implies great expense in carriage. The next best arrangement, then if the work will not afford the stone, must be ascertained. Thoroughly sound bricks, joined with Portland cement, will form good solid blocks, but will necessarily be more expensive than concrete, wherefore the latter will be most generally adopted, and, when properly prepared and carried to a sufficient depth to suit the subsoil, will make a strong, reliable foundation; but a most important point is the choice of ingredients and the mode of mixing them.

There is no lack of experiments upon the composition of concrete and its strength, so there can be no difficulty in specifying the ingredients, but the difficulty is in getting it made to specification. We have made very good concrete with five and one-half parts of clean gravel to one part Barrow lime; but with a great many of our small contractors and so-called jerry builders, anything that will stick together is called concrete. The age of cement concrete greatly influences its strength, as shown by the following table of experiments. The mixture consisted of half cement and half Thames sand, the results being the tensile resistance in pounds per sectional square inch. The cement weighed 123 pounds per bushel:—

Age of Sample.	*Tensile Strength.*
1 week	160 lb.
1 month	201 lb.
3 months	244 lb.
6 months	284 lb.
9 months	307 lb.
12 months	318 lb.
2 years	351 lb.

The average crushing resistance of Portland cement by itself was per sectional square inch, as follows:—Three months old, 1.70 tons; six months old, 2.41 tons; nine months old, 3.13 tons.

There are many different materials suitable for concrete, and one or more will be found in every part of the country; but the proportions of the ingredients will be varied according to their nature and previous experience. In order to proceed scientifically in the formation of concrete, it is necessary to consider its character as a structure.

In making concrete we are really building up a wall, the pebbles or small pieces of broken stone being the material with which it is to be built, and on a smaller scale, corresponding to the stones in rough rubble masonry. Regarded in this light it is evident that the proper quantity of lime to be added, in order to form a suitable mortar to unite the stones, will be regulated only in relation to the quantity and quality of sand contained in the ballast. It is to be observed that upon the proportion of the pebbles to the mortar the strength and goodness of the concrete materially depend, but this in ordinary circumstances will not interfere with the preparation of the mortar; it is a question to be separately considered. On the same principle that in masonry and brickwork the thinner the joint the better will be the work, it follows that to obtain the best kind of concrete we require only sufficient mortar elements to properly unite the pebbles or broken stones.

Dorking stone lime of average quality will form excellent mortar when mixed with three times its own quantity by measure of sand; and although it is quite certain that if it is well burned, ground, and used hot, as it always should be in making concrete, it will make a good mortar when mixed with four of sand, even better if the lime be strong than with less, this may serve as a good general proportion. Ascertaining the best proportion of pebbles to sand is purely a practical and tentative process, and from the bulk of the experience of those most qualified to speak on the subject, the best proportion appears to be two measures of pebbles or broken stone to one of sand.

Some years since some experiments were undertaken with a view to throw some special light on this question. Three masses of concrete of equal bulk were formed in pits prepared for them. No. 1 was formed of screened stones well grouted with lime-water, no sand or small stone being present; No. 2 had four parts of stone and one of sand; No. 3, two parts sand and one of stone; and No. 4, two parts of stone to one of sand. The lime in the last three cases was the same, one-third the quantity of the sand as above proportioned and properly mixed with water. When the concrete was sufficiently set, a sharpened wedge was forced into these samples by means of a lever, and the comparative degrees of resistance varied in the reverse order of the numbers. A variety of other experiments were made, the proportions of the ingredients being altered; but in all cases it was shown that two parts of stone with one of sand, with sufficient lime, dependent on the quality of the materials to make a good mortar with the sand, formed the best concrete.

In preparing concrete *solidity* is the great end to be obtained, and therefore, in view of what we have said as to thin joints, such precautions must be taken as will obviate the occurrence of considerable interstices by which, the work being honeycombed, it would be rendered weak and liable to collapse. Thus, if we have a pit filled with big stones, we may yet put a quantity of smaller ones between them without enlarging the gross bulk, and after that a considerable quantity of sand may be poured in. Variety of sizes of stone employed and the consequent need of sand to fill the crevices is of importance from this point of view, as well as the necessity of its presence to form mortar with lime to cement the stones together, for it must be remembered that no effect will be produced by the lime alone, and practically, it is better to have too much sand than too little.

In the best sample referred to above it will be seen that the proportions were—lime, one part; sand, three parts; and stones, six parts, by measure, the lime forming only one-tenth of the whole mass; and this has been found to be better than using a larger quantity if the proportions of sand and stones are adhered to.

It is essential that the gravel should be freed, by washing if necessary, from all impurities, and the sand should be clean and sharp, for dirt will make neither mortar nor concrete, though this important fact seems to have been overlooked by some of the smaller contractors, and in our own experience during the last few months we have seen several samples of so-called concrete, of which the surface might be easily swept off with an ordinary birch-broom, creating an enormous quantity of genuine dust.

There has been much conflict of opinion as to the various methods employed in mixing and using concrete. The system of putting down the ballast in thinnish layers, and grouting and ramming each layer, is decidedly bad, as the under layer, having quite set by the time the next is being rammed, may be cracked by the blows of the rammer and moreover, we have no guarantee that all the interstices are filled. The proper course to pursue consists in thoroughly mixing the lime, previously ground, with the ballast in a dry state. Sufficient water is then thrown over it to effect a perfect mixture. It should be turned over three or four times with shovels, and used immediately. It is convenient to employ two sets of men to carry out these operations, there being three men in each set. One man is engaged in fetching the water, etc., while the other two turn it over to the second set, who, repeating the process, turn it over to the barrow men, who will immediately wheel it up to a sufficient height above the foundation to cause it to be consolidated by the fall.

In very wet foundations, where a quick-setsing concrete is required, blue lias lime may be used with success, but has the disadvantage that, though it makes a very hard concrete, it is brittle, not possessing the slight amount of elasticity that Dorking lime imparts, causing, therefore, a liability to break under violent concussion.

Amongst the various materials that may be employed in the preparation of concrete, are—clay, which may be burnt into ballast easily and cheaply, and is an excellent material for concrete; gravel; broken stone; crushed furnace slag; smiths' clinkers; oyster-shells; broken glass or crockery; and, in fact, almost any description of hard and durable substance. Where sandstone or any flat stone is abundant, concrete can be made with that material even cheaper than with gravel, the stone being broken up by a suitable disintegrating machine, of which there are several kinds now in the market. It is to be observed that angular fragments of stone will make better work than those of conchoidal shape, which do not give so good hold or key for the mortar. A very serviceable concrete may be made of seven measures of brickfield burrs, seven measures of gravel stones and one measure of Portland cement.

Where appearance is not of so much importance as economy there is, no doubt, a great field for the use of concrete, but it can scarcely be itself fashioned to produce a pleasing effect, and as to stuccoing it over with adventitious decorations, our instincts revolt against that in common with other shams.

Many years back fireproof brick floors were introduced by Messrs. Bunnett and Company, of Deptford, but recently a kind of concrete, in which gypsum is an ingredient, has been extensively used by Messrs. Dennett and Ingle for floors, and also to case ironwork, in order to protect it from heat in case of a conflagration, for it is a well-ascertained fact that unprotected ironwork is not efficient in checking the progress of a fire; wrought-iron girders soften and bend, and cast iron melts.

In using concrete or artificial stone for lintels, etc., its strength transversely does not vary as in beams of elastic material, and in some experiments made upon sample floors of Dennett's concrete above alluded to, by dropping loads upon them, they failed, by the falling loads punching holes through them, so that it would seem that a shearing strain was that under which they succumbed.—*The Architect.*

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The date of expiration of subscriptions is given on the printed address-label attached to each copy of this paper, and is, we trust a sufficient notice to all parties proposing to renew for the ensuing year.

BACK numbers cannot be supplied after February 1st.

WE have been very much overcrowded with work in the past two weeks and have left some matters unattended to. These will be adjusted as fast as possible.

WE will bind ENGINEERING NEWS for parties desiring it. Price $1.50 per Volume; all transportation expenses to be paid by subscriber. We will replace missing numbers so far as possible at rate of ten cents each. Parties sending must be careful to have name written plainly for identification. No time for return is promised as it depends on the bindery.

Municipal Engineering.

We had intended to publish the first paper of the municipal engineering series with our first number in the new year; but though commenced some months ago the field to be covered is so wide, and the sources of information so scattered, that more time has been consumed in preparation than we anticipated.

We can promise the first number, however, before the end of January.

Annual Convention for 1886 of the American Society of Civil Engineers.

The announcement is made that the American Society of Civil Engineers will hold its Thirty-third Annual Meeting in New York, commencing on January 20, at 10 A. M.

The usual annual reports and reports of standing committees will be presented, officers for 1886 elected, and any other business offering will be transacted.

Arrangements for the evening of Jan. 20th, and for Jan. 21, are being perfected by the committee; a visit will probably be made to the new Croton Aqueduct among other points of interest.

Invitations for the next Annual Convention include Denver, Colorado, and Burlington, Vermont. A fair number of the members also contemplate a trip to England to attend the proposed American Exhibition in London, and make a short excursion over the United Kingdom, being absent from New York about six weeks.

The Latest Proposed New York Subway Railway.

We illustrate and describe in this issue the latest plan proposed for increasing rapid transit facilities in this city and at the same time solving some difficult problems of municipal engineering in the better disposal of the electric wires and the intricate pipe system now beneath the surface of our main thoroughfare.

This plan is given for the interest it will undoubtedly possess to engineers everywhere; its successful completion means the expenditure of enormous capital and the further solution of some very interesting bits of engineering that may be developed in the course of the work. But we can see nothing in it that professional skill backed by sufficient capital can not overcome; and judging from the very good business names associated with this enterprise, the means of securing the required capital have been no doubt duly considered.

New York wants a system of subways; its elevated system is hardly capable of extension in any manner adequate to the demands upon it, and the future will certainly see subterranean roads. Aside from adding materially to the avenues of escape from the city, subways would have a decided effect upon the better condition of the roadway under which it passes by making the water, gas and sewers accessible without a break in the street surface, as is now absolutely necessary. A street so tunneled could be paved for all time practically, and the ease in cleaning its regular surface and the greatly increased comfort of the travelling public would soon compensate for the additional cost of such a street pavement as could be laid were other conditions equal?

The usual objections to a tunnel system, of bad ventilation, presence of coal-gas and the noise of passing trains, seem to be well met by the substitution of the electric motor for steam, the division of the tunnel into parallel tight tubes, and the use of an absorbent felted fabric in place of metallic or masonry walls. The total avoidance of the vault space under the pavements will likewise add to its friends among the abuttors on Broadway.

The Keithsburg Bridge.

As addenda to the short description of the Keithsburg bridge, in our issue of Dec. 19, we add from the *Keithsburg Times* of Dec. 23, the following:

This bridge was chartered about 1882, under the name of the Mercer Co. Bridge Co., of Illinois, and the Keithsburg Bridge Co., of Iowa; the two were afterwards consolidated under the latter name. The present company is largely composed of the directors of the Central Iowa Railroad Company.

The bridge entire was let to the Phœnix Bridge Co., about June 1, 1885, who sublet the substructure to Gen. Wm. Sooy Smith & Son, and the masonry to Drake & Stratton.

The length of spans and approaches have already been given. J. F. Wallace was engineer-in-charge until August 1, 1885, and was then succeeded by George A. Lederle, the duties of Mr. Wallace as Master of Transportation interfering with his services on the bridge.

The eleven piers contain 3,420 cubic yards of masonry; each pier is founded on 70 piles, sawn off 4 feet below low water, capped by 12x12-inch timbers, and 12x12 inch grillage. The pivot-pier has under it 104 piles; this pier is 34 feet 10 inches in base diameter and 30 feet at the top, and is 26 feet 5 inches high; it is cased in cut-stone with a hearting of concrete.

The cost of the bridge proper was about $290,000, and engineering and sundry expenses add to this $10,000.

Tunnel Accidents on the South Pennsylvania Railroad.

In connection with the much talked about frequency of fatal accidents on the new Croton Aqueduct tunnel, we publish below a list of fatal accidents on and about the tunnels of the South Pennsylvania railroad. This latter list of killed is larger than generally supposed; seventy-five per cent. of the deaths were caused by falling rock from the roof, which was, however, of much greater span and more treacherous material than in the Aqueduct tunnel. The absence of any shaft accidents is due to the fact that there were no shafts on the tunnels of the South Pennsylvania railroad. The class of labor was very much the same on both works; a mixture of nationalities, Hungarian and Italian labor predominating. The time rate of accidents in the two places is eight months for the Aqueduct and thirty-nine men killed, as against forty-six months in the South Pennsylvania tunnels, and twenty-seven men killed. The pay-rolls of the Aqueduct work, however, carry nearly twice the number of men employed in the railroad tunnels.

We give the following official list as a matter of record and for future reference; the time was forty-six months: work done, four and one-third miles of tunnel driven and value of work, $4,000,000; the total progress in the Aqueduct to November 1 was about five miles, including the shafts.

Accidents in Tunnels.

May	10, 1884.—Allegheny Mountain Tunnel, rock fell from the roof and killed	1
May	28, 1884.—Laurel Hill Tunnel, west end, a large section of roof fell at portal, due to an unsuspected water-bearing stratification, killing	7
Aug.	6, 1884.—Tuscarora Tunnel: a rock fell from the roof, killing	2
Oct.	21, 1884.—Blue Mountain Tunnel, east end, a rock fell from the roof, killing	1
Nov.	14, 1884.—Ray's Hill Tunnel, west end, a rock fell from the roof while men were preparing s pports, killing	1
March	26, 1885.—Sideling Hill Tunnel, east end, a rock fell from the roof, killing	2
April	6, 1885.—Allegheny Mountain Tunnel, a rock fell from the roof, killing	1
June	16, 1885.—Quemahoning Tunnel, west end, while dressing sides, the wall plates were undermined, allowing timber arches and packing to fall, killing	1
July	6, 1885.—Sideling Hill Tunnel, premature explosion, killed	3

July 16, 1885.—Blue Mountain Tunnel, east end, suffocated by fumes..... 1

Total in Tunnels..... 20

Accidents on Open Work.

Jan. 10, 1884.—Allegheny Mountain, open approach cut, a rock thrown by blast, killed. 1

April 11, 1884.—Section 125. A blast hung fire and killed..... 1

July 21, 1881.—Section 166. Powder explosion, killed..... 1

June 23, 1884.—Division 4. Driver run over by car and killed..... 1

July 8, 1884.—Section 127. Premature explosion..... 1

July 20, 1881.—Section 65. Premature explosion 2

Total in open work..... 7

Summary.

Accidents in tunnels..... 20
" in open work..... 7

Total..... 27

Improving Philadelphia's Highways.

The special Committee, on Highways of the City Councils of Philadelphia have submitted their report, under date of Oct. 26, on a plan for the better paving of the highways of that city. After consulting with Capt. F. V. Greene, U. S. Engineers, and other experts, and gathering information from other available sources, concerning street railways, they recommend, practically, as follows:

That the sum of $200,000 be appropriated for repaving streets occupied by passenger railways, where the companies will pay one-half the cost; and $100,000 for repaving streets not occupied by railways, where the property owners will pay one-third of the expense; and that these sums be inserted in the annual appropriation for the Department of Highways for 1886, for the purpose of commencing a system of improved street pavement in Philadelphia, to be continued from year to year.

The committee further states that this work should commence at once, as the present streets are a disgrace to the city, a great inconvenience to the travelling public, and impossible to keep clean; the money yearly expended in repairing cobble-stone pavement is practically thrown away, as it must be done each year.

Wm. H. Kemble, President of the Union Line Company, suggested that on certain streets he would do the work if the city would pay $1.35 per square yard; in other words, for work costing $2.35 per yard, he would pay $1.00. Mr. C. J. Harrah, President of the People's Line, said he would do the same, and Mr. A. M. Fox of the Second and Third Streets Railway Company, said he would comply with any reasonable demand. Others of the street railway companies were indefinite in their answers to queries.

The evidence of Capt. Greene, as given to the committee, contained much of interest and importance on this popular subject. He gave them practically the result of his own long experience in Washington and of the inspection of most of our own large cities and of Liverpool, London, Paris and Berlin.

He stated that the streets, and especially the tramways abroad were much better than ours. American street railways lacked solidity of road-bed; the rail is usually of a form that will twist and turn the wheels of vehicles passing over them; the substructure is wood and the cross-ties project 4½ inches beyond the longitudinal stringers requiring the pavement to be removed whenever the track is relaid. The rails draw the spikes out, the tracks are almost constantly wet and the wood consequently rots out so that it must be renewed about once in seven years.

In Liverpool he saw double-decked cars carrying about forty-five passengers hauled by two horses at a pace of fully seven miles per hour. The rail in this case was center-grooved and would hardly be noticed in the streets, the wheel was center-flanged; though he afterwards found that the wheel systems abroad were about equally divided between center and side-flanged. In England the entire system of tramways had been rebuilt within the last six years. They are now laid on a bed of concrete and fully nine-tenths of them have a longitudinal sleeper of cast-iron imbedded in the concrete to which the wearing surface of steel is attached by bolts or other fastenings; the last part only is renewed, the entire substructure remains untouched and will last for an indefinitely long period.

In England the cost of tramways is divided into three parts, *i. e.*, iron-work, cost of laying and cost of pavements. The various systems cost, for iron-work, from $7,000 to $12,000 per mile; for laying, from $500 to $700, and paving for about 8-feet wide, allowing 18-inches each side of track, at $2.50 per yard amounts to about $10,000 per mile. A Philadelphia track, 8-feet wide with a 50 pound rail, would cost per mile about as follows:—78½ tons of steel rail at $30, $2,355; 63,660 feet B. M. of timber at $18, $1,140; angle-iron braces and spikes $51, and laying, $600. The cost with wooden superstructure is thus about $4,147 per mile, and adding a cobble stone pavement at $2,346, the total would be $6,493.

Contrasting this with the Manchester system with a 40 pound rail, as heavy as is needed any where, we have as follows:—63 tons steel rails, $1,890; 206 tons of cast-iron, $4,132; eleven tons of anchors, $295; bronze bolts, $1,400, and track laying $600; or a total of $8,300 per mile for cost of track. The paving added at $2.35 would run the total up to $19,300 per mile. But the latter estimate is for concrete, iron and a first-class pavement, the latter item being more than one-half of the expense.

Capt. Greene estimated the cost of maintenance, taking interest at 6 per cent., and assuming the life of the rail at 20 years, and timber at 7 years as being $1,225 annually for the wood and cobble track. On the concrete and iron track it would be $1,737 per year. But at 3 per cent. these figures come down to $1,030 and $1,150 per annum, substantially the same with the interest on the first cost of the permanent track about balanced by the constant repairs on the temporary roadway.

In Liverpool, Manchester and London the prevailing pavement alongside and between the rails is granite block: in Paris it is partly granite block and partly asphalte, and in Berlin it is wholly asphalte.

In answer to a question concerning the quality and kind of pavement most desirable on the built-up streets, Captain Greene answered as follows: That while the committee of experts of 1884, of which committee Captain Greene was a member, recommended granite block for the narrow streets, he now finds good cause for changing his opinion. An examination of pavements in many American cities has convinced him that on narrow streets with heavy hauling the granite pavement will develope ruts, the result of a succession of slight blows in about the same spot. These blows do not occur on sheet asphalte pavement and in Boston he saw a pavement of the latter description four years old that had sustained very heavy traffic from trucks carrying up to 11 tons, that until the summer of 1885 never needed repair. He thus recommended sheet asphalte and showed that there were fewer ruts in an asphalte pavement laid on Sixth St. in Philadelphia 10 years ago than in the adjoining granite pavement.

In referring to the breaking and relaying of pavement, Capt. Greene stated that asphalte was much to be preferred to Belgian or stone-block. The Belgian blocks could never be put back just in the same place; the bond was broken and the street would settle. In repairing a break in an asphalte pavement new material was used entirely, and the bond and joint was as good as before. In Washington, where this latter pavement is being continually broken for building purposes, the practice was to compel the plumber to deposit $10 when getting his permit; the hole made is usually about 4 feet by 2 feet, and when the plumber was through, the contractor for repairs was notified, and he fixed it at a cost of from $2.50 to $3.00 per yard which the plumber must pay. The average of maintenance of a good asphalte pavement was put down at 10 cents per yard per year; Washington streets cost about 5 cents per year.

In cleaning the streets in St. Louis, the bids for cleaning asphalte pavements are 25 per cent. below those based on granite block. In Washington the street cleaning costs from 29 to 35 cents a thousand yards cleaned once.

The wear and tear on vehicles is another item worthy of consideration. In London at the time the American rail was laid in the streets, the Omnibus company made a statement that it cost them $75 per month for each omnibus for repairs when driven on tramways, as against $47 where there were no tramways. The result of driving over cobble-stone vs. asphalte may be guessed at.

Capt. Greene submitted to the committee a steel rail of his own design weighing 40 pounds per yard with a cast-iron stringer weighing 130 pounds per yard, set in concrete. The report closes with a translation of M. Barabaut's report on English tramways to which we will again refer.

PERSONAL.

W. A. Keller, of Kauffman & Keller, coal dealers, son of John Keller, a prominent railroad contractor, and Miss Lizzie McGovern, a daughter of the late John R. McGovern, who was also a prominent railroad contractor, all of Lancaster, Pa., were married, Dec. 30, in St. Mary's Convent Chapel, Lancaster, Pa.

Mr. William W. Kenly, of Baltimore, has resigned his position as the Engineer inspecting the erection of the bridge across the Susquehana river on the Philadelphia branch of the Baltimore and Ohio R. R., and has been appointed Assistant to the General Manager on Construction, Atlantic Coast Line R. R. His office and headquarters will be at Wilmington, North Carolina.

Professor Donelson, the senior of the English architects, one of the most prominent founders and ex-president of the Institute of Architects, died August 1, 1885, in London, at the age of 90 years. His name is known all over the world on account of his studies of the classic architecture. He spent five years in Italy and Greece, working hard and enthusiastically in sketching and surveying the remains of the tempels in Athens, Teos, Epheaus, Aegina, and Bassae. His labors have contributed largely to the knowledge of the antique-architecture. His most prominent publication is the supplement to Stuart's and Revett's "Athens," in which work he was assisted by Cockerell and Kinnaird.

E. T. Jeffrey has just been promoted from general superintendent to general manager of all the Illinois Central R. R. lines. The last office was created for him. Mr. Jeffrey commenced with the company as an office boy, and has been rapidly promoted to his present

position. He came up, as it were, by the way of the machinery department.

Married at Belleville, Ont., Dec. 21, 1885, by the Rev. Mr. Clarkson, W. J. CARROLL, C. E., St. Catherines, to LOTTIE M., eldest daughter of HORACE A. YEOMANS, Esq., of Belleville.

MR. CARROLL has been engineering on the Denver and Rio Grande and Canadian Pacific Railroad for six years past, and will sail for Buenos Ayres, S. A., next week.

Western Penna. Society of Engineers.

At the monthly meeting of the Pittsburg, Pa., Society of Civil Engineers, held Dec. 15, a paper was read by Capt. Hunt. Mr. Metcalf stated during the discussion that he considered pure steel to consist of iron and carbon in proportions according to its use, and not containing more than 1—200th of one per cent. of impurities.

Captain Hunt stated that the Pittsburg Testing Laboratory had decided that the manufacturers using old rails in place of muck-bar in making iron, must so state in their specifications, out of fairness to the competitors, without regard to the success of the test.

Other members considered that the material of which structural iron was made should be specified. Mr. Zimmerman stated in support thereof that iron made of old rails might pass the chemical and mechanical tests, and yet might not prove so durable as iron made from muck-bar.

Resolutions of respect on the death of A. J. Coulter, a member of the society, were passed, as was a resolution thanking the Chief Engineer of the United States Army for documents furnished the society.

The Committee on Nominations presented the following names to be balloted for at the next meeting: President, S. F. Fisher; Vice President, E. B. Taylor; Secretary, S. M. Wickersham; Treasurer, A. E. Frost; Directors, W. L. Scaife and F. C. Phillips.

Illinois Association of Engineers and Surveyors.

Prof. I. O. Baker, of Champaign, Ill., has issued Circular No. 2 to the Engineers and Surveyors of Illinois, calling for a convention to be held at Champaign, on February 10th, for the purpose of organizing a State Association. The University of Illinois has offered the use of a suitable room.

The following provisional programme is proposed as a basis for suggestions; the details of the programme are to be arranged later:

1. *Preliminary Organization*:—Discussion of the objects and aims of the association. Appointment of committees.

2. *Agricultural Drainage*:—(a) Open Ditches. (b) Tile Drains.

3. *City Engineering*:—(a) Street Pavements. (b) Water Supply. (c) Sewerage.

4. *Road Improvement*:—(a) Gravel Roads. (b) Common Highways. (c) Contract vs. Pathmaster System. (d) Bridges and Culverts.

5. *Land Surveying*:—(a) Discussion of questions relating to practice. (b) Legal questions.

It is to be hoped that this circular will receive a large and favorable response from the Engineers and Surveyors of the great State of Illinois. A vast deal of very practical and useful professional information has been accumulated in the past three years by societies in the states adjoining Illinois, and there is no doubt of the success of a similar organization in this state. Let every man addressed lend a helping hand to the movement.

Connecticut Civil Engineers' and Surveyors' Association.

SECRETARY'S OFFICE, NEW HAVEN, CT.,
Dec. 21, 1885.

DEAR SIR:—The second annual meeting of the Association for the election of officers, will be held at Hartford, Conn., in the Common Council Room, No. 300 Main Street, on Tuesday, January 12, 1886. Headquarters will be at the City Engineer's Office, No. 300 Main Street. The members are invited to bring duplicate sketches 10x15 inches of some devise for mutual exchange. You are specially requested to inform Mr. C. H. Bunce, of Hartford, Conn., before January 10, 1886, if you can be present, in order to make proper arrangements for dinner.

Respectfully Yours,
D. C. SANFORD, Sec'y.

PROGRAMME.—10.00 A. M.—Opening Exercises, Election of Officers, etc. 1. Paper on Sewer Gasses, by F. W. LaForge, Waterbury, Conn. Dinner at United States Hotel. 2.00 P. M.—Synopsis of the proposed change of grade crossing over the tracks of the N. Y., N. H. & H. and the N. Y. & N. E. Railroads, at Asylum street, Hartford, Conn., by C. H. Bunce, Hartford, Conn. 1. Regulation of House Drainage, by C. E. Chandler, Norwich, Conn.

Liverpool Engineering Society.

The usual fortnightly meeting of this Society was held at the Royal Institution, Colquitt-street, on Wednesday, December 9, when the President, Mr. W. E. Mills, delivered his retiring address. After a few preliminary remarks, the author stated that he proposed to give a short review of the art of engineering, looked at in a threefold aspect—first, what it had been in the past; second, what it is now in the present; third, what it is likely to be in the future. In the first division, the engineering works of the ancient Egyptians were described, and the first faint indications of the use of steam-power by Hero of Alexandria. The Aqueducts, roads, and fortifications of the Roman Empire followed, and their improvement, and the developement of military engineering which took place during the Middle Ages were next considered and illustrated. The advancement of the steam engine from Newcomen to Watt was described in detail, and the achievements of Telford and Brindley, in designing and improving a system of roads and canals respectively, were recounted. The introduction of railways, the locomotive engine, and steam navigation served to bring the first part to a conclusion.

In the second division the various improvements in the steam-engine, especially in its application to agriculture, and the design of structures, such as bridges and roofs of large span, were touched upon. The development of electricity in its applications for lighting and motive-power was traced, together with its attendant inventions of the telephone, microphone, and photophone, while the extended use of hydraulic power received special mention. The third division was occupied with speculations on the probable nature of the future direction and scope of the various subjects treated of in the preceding.

The conclusion of the address was devoted to considerations on the education best fitted for those who intend to become engineers. The want of technical schools throughout the country, of which Sir William Fairbairn had pointed out the necessity more than thirty years ago, was strongly commented upon, while the appointment of a Professor of Engineering at University College was regarded with much satisfaction as a step in the right direction, and all (especially students) were urged to avail themselves fully of the advantages offered by means of the classes and lectures now set on foot.

Effect of the Enlargement of St. Mary's Canal.

The recent enlargement of the locks in St. Mary's Ship Canal, on the rapids below lake Superior, so as to admit vessels drawing 16 feet, and several of them at a time, has had a marked effect on trade. A writer says:—

Not only have freight rates fallen even more than half, but the tonnage passing these locks shows a tremendous increase over any previous year in this the first year of these completed improvements. To illustrate: If the same ratio of increase is continued through the balance of this season, there will pass through the canal going eastward alone over 2,700,000 tons of freight, or as much as the eight trunk lines of railroad took east from Chicago last year, the same being the products of our forests, fields, and mines. The receipts of coal at the head of the lake have increased from 60,000 tons, in 1880, to 600,000 tons in 1885. The receipts of wheat there have increased from 1,500,000 bushels, in 1880, to 14,000,000 in 1885. The elevator and storage capacity increased from 540,000 bushels, in the spring of 1880, to 9,400,000 bushels this year, and 3,000,000 more to be immediately built. As a wheat market it has grown from daily sales of a few car loads, no longer ago than 1884, to a wheat market second only in amount of its daily sales to Chicago, with everything tending to show its daily wheat transactions will equal even that "modern marvel" in the coming year. That has built up there a busy population of 20,000 from about 4,000 in 1880.

Receipts of Montana shipments in 1884 at the head of lake Superior for cheap water transportation east, took marine insurance of about $4,000,000, and so far this year shows a large increase over last year. Additional to this amount, last year also shows the beginning of Montana cattle shipments to the improved waterway of lake Superior, that in a near future will exceed the value for this year whatever it may be.

This improved waterway has made possible the opening of the iron deposits of Wisconsin. Those of the Minnesota Iron Company, opened last year, will ship from their port of Two Harbors, twenty-eight miles east of the head of the lake, some 250,000 tons, equal to 18,000,000 bushels of wheat. Freight rates from Duluth to alongside the ocean steamers or into elevators at New York were at an average rate this season of a fraction less than six cents per bushel and as low as three and one-half cents to alongside ocean steamers at Montreal. A good proportion of grain that has left there this season has been carried to Buffalo, 1,030 miles, for one and one-half cents per bushel, or less than the usual elevator charges from cars to elevators.

QUESTIONS AND ANSWERS.

The Cost of a Patent.

J. R. H. Will you kindly inform the writer through your columns what would be the total expense of securing a patent on an improved row-lock for row-boats etc., (a very simple device.)

[From the circular of a well-known firm of New York patent lawyers, we find the cost for conducting an application for patent involving a *minimum* amount of labor, the charge is $70, payable as follows: Deposit with order $20; due when papers are ready, $30; due after patent is allowed, $20. Total $70. When more than one sheet of drawings is necessary, the charges will exceed this.]

E. B. W., FREEPORT, ILL. You can buy an Anemometer from Keuffel & Esser, advertised on another paper. Prices range from $18 to $75.

G. J. S., SAN FRANCISCO, CAL. How many pounds of coal in one bushel, measured as in England and in Pennsylvania?

I would also like to have some information about large draw-bridges built in the United States which require hydraulic machinery to turn them.

Approximate Estimate of Cost of Tunnel Excavation per Cubic Yard.

DIVISION NO. 2, SOUTH PENNA. R. R. DEC. 10, 1885.

W. H. Atwood, Formerly Div. Engineer

	Location.	Kind of Material.	"Dip" of Rock.	Period of time from which results are obtained.	Prescribed Section of Exca., C. Yds.	Amount Excavated within Prescribed Section.	Length of Haul. Heading to Bench.	Length of Haul. Bench to Dump.	Labor. Common Labor and Foremen.	Labor. Superds. Time-Keepers and Clerks.	Plant and Tools. Interest and Depreciation.	Plant and Tools. Small Tools and Repairs.	Fuel and Oil.	Explosives.	Sundries. Freight Hauling, etc.	Total Cost.	
				1885.	C. Y.	C. Y.	Feet.	Feet.	$	$	$	$	$	$	$	$	
BREAKING.	"East Blue."	Red "Medina Sandstone .... Hard.	75° West	April, May	3.8	1576	50	.....	1.89	0.19	0.47	0.33	0.60	1.95	0.053	5.488	Heading.
	"West Blue."	"Clinton Olive" Shale.....	70° West	June and July..	6.9	2885	.....	2750	0.94	0.11	0.26	0.18	0.35	0.48	0.023	2.389	Bench.
	"West Blue."	Slightly Bolton along Seams "Clinton Olive" Shale ..... Hard.	70° West	March and April May (heading)..	5.6 10.0 3.7	1178 3197 665	110 100	..... 1700	0.95 0.33 1.19	0.10 0.04 0.19	0.29 0.11 0.25	0.14 0.05 0.12	0.37 0.14 0.36	0.60 0.13 0.92	0.044 0.013 0.039	2.494 .813 3.069	Heading. Bench. Heading.
	East	"Clinton Olive" Shale .... Hard.	20° East & West	June (bench).... Feb. and March	7.3	1287	.....	2150	0.68	0.10	0.13	0.06	0.18	0.24	0.016	1.406	Bench.
	Kittatinny..				3.7	1120	100	.....	1.14	0.11	0.19	0.10	0.38	1.36	0.057	3.337	Heading.
	East	"Clinton Olive" Shale ..... Hard.	45° East.....	May and June..	7.0 3.0	2583 922	 120	2350	0.57 1.55	0.04 0.14	0.12 0.26	0.06 0.12	0.16 0.37	0.35 1.50	0.021 0.070	1.321 4.010	Bench. Heading.
	Kittatinny....				7.7	2341	.....	3000	0.62	0.05	0.13	0.07	0.21	0.41	0.022	1.512	Bench.
	West.....	Red "Medina" Sandstone... Hard.	84° East.....	Feb. and March.	3.0	638	50	.....	2.39	0.19	0.44	0.24	0.67	2.20	0.12	6.250	Heading.
	Kittatinny...				7.7	1659	.....	2400	0.78	0.07	0.17	0.09	0.25	0.55	0.04	1.950	Bench.
	West	Red "Medina" Sandstone... Hard.	84° East.....	June and July..	3.2	412	60	.....	3.76	0.29	0.75	0.40	1.13	2.00	0.184	8.514	Heading.
	Kittatinny....				7.5	946	.....	2300	1.28	0.12	0.27	0.15	0.39	0.50	0.074	2.784	Bench.
LOADING AND DUMPING.	East Blue	RATES OF WAGES USED. Superintendent ..... $6.00 per day. Time Keepers ..... 1.50 " Book " ..... 2.50 " Engineer .. .. 3.00 " Blacksmith..... 3.00 " Foremen..... 2.50 " Drill Runners..... 2.00 " All other labor ..... 1.25 " Horses ..... 1.00 "	PRICES OF EXPLOSIVES USED. cts. per lb. Dynamite (40 % Nitro-Glycerine) 16 " 60 " 23⅜ " 75 " 31⅜ Fuse, Connecting Wire, etc., (7 % of price of Powder.	COST OF PLANT USED. This "Cost" is the estimated cost in place of Compressors Boilers, Drills, Piping, Track, Cars, Buildings, Pumps and Ventilating Apparatus.					$15 000.00	0.700	0.054	0.014	0.022	0.013	.....	0.006	.809	Heading Material to Cars.
	West Blue....									0.940	0.054	0.004	0.012	0.007	.....	0.003	1.024	Loading Bench.
										0.037	0.019	0.003	0.004		.....		.083	Dumping Heading and Bench.
	West Blue....									0.650	0.026	0.003	0.012	0.009	.....	0.004	.710	Heading Material to Cars.
										0.510	0.014	0.003	0.003	0.003	.....	0.002	.535	Loading Bench.
									14.500.00	0.015	0.007	0.002	0.002		.....		.058	Dumping Heading and Bench.
										0.540	0.05	0.008	0.010	0.007	.....	0.004	.619	Heading Material to Cars.
										0.610	0.036	0.004	0.004	0.004	.....	0.002	.660	Loading Bench.
										0.075	0.017	0.002	0.002		.....		.096	Dumping Heading and Bench.
	E. Kittatinny									0.700	0.028	0.006	0.012	0.009	.....	0.004	.759	Heading Material to Cars.
										0.740	0.017	0.003	0.006	0.004	.....	0.002	.752	Loading Bench.
										0.058	0.008	0.001	0.002		.....		.069	Dumping Heading and Bench.
	E. Kittatinny								12.000.00	0.770	0.035	0.007	0.015	0.011	.....	0.005	.843	Heading Material to Cars.
										0.800	0.019	0.003	0.006	0.004		0.002	.834	Loading Bench.
										0.082	0.010	0.001	0.002		.....		.095	Dumping Heading and Bench.
										1.190	0.050	0.009	0.020	0.016	.....	0.008	1.293	Heading Material to Cars.
	W. Kittatinny									0.960	0.026	0.004	0.008	0.006	.....	0.003	1.006	Loading Bench.
										0.088	0.014	0.002	0.003		.....		.107	Dumping Heading and Bench.
	W. Kittatinny								12.000.00	1.200	0.076	0.013	0.031	0.024	.....	0.012	1.356	Heading Material to Cars.
										0.930	0.046	0.006	0.014	0.010	.....	0.005	1.011	Loading Bench.
										0.092	0.032	0.003	0.005		.....		.132	Dumping Heading and Bench.
TRANSP. per 100 feet.	East Blue....	COMPRESSORS USED. 18 by 30 inches Ingersoll ..... 16 by 24 inches " ..... 20 by 30 inches " ..... Located at East End and supplied air for both ends. Connection with West End was by a 3 inch W. I. pipe.	GENERAL NOTES. "Strike" of Rock was in all cases nearly at right angles to center lines. Drainage was natural at all points except West Blue – where there was a down grade of 0.8 feet per 100 feet, and pumping was constantly required. No ventilating apparatus used during period covered by this report, except during hot weather at East Blue.						0.230	0.01	0.028	0.044	0.013	.....	.....	.325	Heading to Cars.
	West Blue....									0.012		0.003	0.002		.....	.....	.017	Head. & Bench Mat. to Dump.
	West Blue....									0.114	0.01	0.008	0.011	0.004	.....	.....	.147	Heading to Cars.
										0.009		0.002	0.002		.....	.....	.013	Head. & Bench Mat. to Dump.
	E. Kittatinny.									0.100	0.01	0.008	0.010	0.004	.....	.....	.132	Heading to Cars.
										0.022		0.002	0.001		.....	.....	.025	Head. & Bench Mat. to Dump.
	E. Kittatinny.									0.121	0.01	0.006	0.012	0.004	.....	.....	.153	Heading to Cars.
										0.008		0.001	0.001		.....	.....	.010	Head. & Bench Mat. to Dump.
	E. Kittatinny.									0.114	0.01	0.006	0.012	0.004	.....	.....	.146	Heading to Cars.
										0.007		0.001	0.001		.....	.....	.009	Head. & Bench Mat. to Dump.
	W. Kittatinny									0.340	0.02	0.017	0.040	0.016	.....	0.006	.439	Heading to Cars.
										0.012		0.002	0.001		.....		.015	Head. & Bench Mat. to Dump.
	W. Kittatinny									0.300	0.02	0.022	0.052	0.020	.....	0.008	.414	Heading to Cars.
										0.012		0.004	0.003		.....		0.19	Head. & Bench Mat. to Dump.

CORRESPONDENCE.

Sewerage of Omaha.

CITY ENGINEER'S OFFICE.
OMAHA, NEB., Dec. 24, 1885.

EDITOR ENGINEERING NEWS:—In your issue of the 12th, you credit Mr. Chester B. Davis with designing the sewerage of the city of Omaha. You evidently intended some other locality, as Mr. Davis has never been employed by the city of Omaha, in connection with sewerage or any other public works. The sewerage of Omaha covering about twenty four miles of work varying in size from 6 inches to 8½ feet in diameter was designed partly by R. C. Philips—Col. Geo. E. Waring and myself. Very Respectfully,

ANDREW ROSEWATER.

[The city of Lincoln, Neb., was intended.—ED. ENG. NEWS.]

Ann Arbor Water Works.

SPRINGFIELD, Mass., Dec. 28, 1885.

EDITOR ENGINEERING NEWS:—In your issue of 19th you make some statements regarding Ann Arbor, Michigan Water Works, not quite correct.

The City pays for the use of 100 hydrants $4,500 per year, and for other city purposes $500 per year, making the amount paid by the city $5000 per year. As people are apt to compare prices paid by other cities, while they are investigating the subject for their own, please, make the correction, although we consider water like any other article of merchandise worth what it costs to produce. It may be cheap for a city at $80 per hydrant, or dear at $50, as to the situation.

Yours Truly,
GOODHUE & BIRNIE.

Tall Stand Pipes.

BLOOMINGTON, ILL., Dec. 22, 1885.

EDITOR ENGINEERING NEWS.—I observe in your issue of December 12, 1885, a short article upon "Tall Stand Pipes and the Practicability of enclosing the same with Brick Masonry." We have had in actual use here in our city such a stand pipe since the year 1876. It has given very satisfactory results, and the citizens of Bloomington, I think, would recommend it without any exception. There was first constructed a foundation of stone masonry, being octagonal in form. Upon this foundation was set a heavy casting which forms the base of the stand pipe. The stand pipe proper is built of sheet iron, put together in sections and rivetted; is eight feet in diameter in the clear, and two hundred and four feet high. The entire pipe being encased in brick masonry and the top ornamented with platform railing, cornice, etc. The wall is built two feet from the pipe, and there is a winding stairway to the top, with occasional platforms and windows inserted for the admission of light and air. The wall is six feet thick at its base, its exterior ascends with a slight batter for about thirty feet, where there is an ornamental bridge cornice; from here it takes the form of the parabola and thence on a tangential batter to top where the brick masonry is but one foot in thickness. The brick work has held its own very well, there being no perceptible deterioration except in the very upper portion, where a slight crack is observable. I am unable to determine whether this defect is the result of oscillation or the action of the weather in destroying the bond of the masonry. Respectfully yours,

A. H. BELL.

News From Ohio.

URBANA, O., Dec. 26th 1885.

Special Correspondence Engineering News.

The Y. M. C. A., of Dayton, Ohio, will build a house for their special needs. It is to be of stone, 66 feet wide, four stories and basement. The contract will be let this winter.

Upper Sandusky, Ohio, is discussing water-works.

At Mt. Blanchard, Ohio, in boring for oil, at the depth of 100 feet the drill passed through a four feet vein of coal.

Civil Engineer, W. C. Agnew, has commenced a survey of a line from Akron to Chicago Junction, Ohio, a distance of 70 miles, linking the Baltimore & Ohio road to the Cleveland, Pittsburg & Toledo, R. R.

Findlay Ohio, has made another successful strike of natural gas. The flow from the new well is estimated at 400,000 feet daily. Eleven wells have been put down, nine of which discharge large quantities of gas.

There are seventeen flowing natural gas wells in northwestern Ohio. Wapakoneta has failed to find gas on the fourth attempt.

Barnesville, Ohio, is a town of mud streets, and the weekly papers find it necessary to urge that teams be prevented from resting on the crossings. This is not creditable for any town in Ohio that is the county seat of a county containing nearly 50,000 people.

A vein of very superior coal, thirteen feet thick has been found in Brush Creek, Muskingum Co. Ohio.

The enameled brick made by Townsend & Co. at Zanesville, are quite popular with architects, and recently an order was received from California for enough to finish a magnificent block.

Mr. George A. Parker, of Boston, has been awarded the contract for building the division of the Black Diamond Railway that lies between Zanesville and Malta. The road is located in the Muskingum valley. Colonel E. A. Greene is Chief Engineer.

Delaware, Ohio, is agitating the establishment of a system of electric lights in the city. The ordinance before the council, which is causing considerable discussion, in effect is to grant J. F. Cole the right of way through, in and upon the streets, alleys, sidewalks and public grounds of the city, and the right to erect the necessary wires, posts, etc., the said Cole to maintain the system in good order, the city reserving the right to grant the same privileges to any other Electric Light Company.

One of the questions at a recent County Teacher's examination in Delaware Co., Ohio, was "Describe the drainage system of North America."

On Jan. 5, 1886, the Auditor of Delaware county will receive bids until 1.30 P. M. for the construction of two wrought iron bridges over the Scioto river. Plans and specifications are on file at the Auditor's office in Delaware, but bids are also solicited on any other plans.

Mansfield and Delaware, Ohio, are connected by a copper wire used for telephone. Distance about 50 miles.

According to the published report, the County Commissioners of Delaware county, Ohio, expended over $9,000 during the year ending September 1,1885, for the construction of bridges, masonry, culverts, and repairs, and yet not an item appears to show that the services of an engineer were ever employed on any of the work. The practice of County Commissioners in many parts of the state to superintend (?) and attend to the plans and construction of bridges and culverts, is an expensive luxury to everybody, except the commissioners themselves, and merits severe condemnation. From an item in the Delaware *Gazette*, it appears that they have thought it necessary to emplor an engineer, Mr. W. C. Dennison, to superintend the construction of the bridges over the Scioto. This is as it should be, and the sooner the planning, constructing and caring for all bridges, culverts and masonry are placed in the hands of a competent engineer, the sooner will taxation to replenish and keep up the bridge fund be lowered to the least possible amount.

A natural gas company has been incorporated at Urbana, O, with a capital stock of $25,000. The company has organized by electing directors, and they are quietly waiting developments at Sidney, Findlay and Springfield before beginning work.

Illinois and Indiana News.

CHAMPAIGN, ILL., December 26, 1885.

Special Correspondence ENGINEERING NEWS.

The electric railway in South Bend, Ind., seems to be a success. The Van Depoele motors work to a charm. A little difficulty has been experienced at the curves, but it is thought that that can readily be overcome, when the system will be in perfect working order. The car is quickly started and stopped, and can be run at any desired speed.

At Frankfort, Ind., an unpaid contractor on the Air Line Railroad through that place garnished the sum of $1,700, which had just been paid into the treasury as a donation from one of the townships to aid in its construction.

J. G. Miller, a prominent contractor of Washington, Daviess county, Ind., skipped out recently, leaving a host of creditors in the lurch. He had the contract for the construction of Gibson county's new court house, and had pushed the work almost to completion when the pressure from his creditors became so strong that he sought release from their importunities in flight.

B. J. Gifford, of Rantoul, Ill., has the contract for cutting some twenty miles of ditches in Big Slough, near that place; the price is 11 cents per yard, and the estimated total $40,000. He intends to make the ditch with his hydraulic plow (already described in ENGINEERING NEWS), of which three new ones are now under construction; it is intended to work them in gangs of two or three closely following each other. We are desired to state, in answer to numerous correspondents, that the plows will not be put to work until the frost is out of the ground, when a public trial will be given. A NEWS representative will attend the trial and furnish a report for our readers.

A very spirited contest is being waged before the United States Treasury Department as to the relative merits of Indiana limestone and Maine granite for use in the new post-office and government building at Pittsburg, Pa.

Champaign and Urbana, Ills., have tested and formally accepted the joint water-works for the two cities. The water is obtained from an abandoned prospect coal-shaft; it is raised by two duplex compound pumps, having 50 feet vertically between the cylinders. At present the system is direct pumping, but as soon as a little experience shows the size of stand pipe best suited to the purpose, one will be built. It is proposed to close the top of the pipe air-tight and utilize the pressure of the enclosed air; in this way the equivalent of 55 feet of water will be obtained. So far as we know, the only thing similar is at East St. Louis, where the air is pumped in.

Senator Harrison has introduced in the Senate bills providing for public buildings at Madison and Richmond, Ind., to cost $75,000 and $100,000 respectively.

In boring for water at Streator, Ills., a vein of natural gas was struck at a depth of 150 feet. The flow is 5 inches in diameter and blazes 20 feet high when lighted.

The Midland Railroad Company has thirty-six cars of steel rails at Indianapolis, ready to be laid on the road as soon as the contractors have settled a little difference between themselves.

A. H. Bell, city engineer of Bloomington, Ills., was the engineer of the Mason and Tazwell Drainage District and is at present acting as such for the Drainage District in Piatt Co. He has also laid out the work on three other Drainage Districts in this State.

The Elgin City Water-Works Company has been incorporated at Elgin, Ill.; capital stock, $150,000; incorporators, Andrew C. Hawkins, Henry I. Bosworth, August Nolting, R. P. Jackman, John Newman, and William F. Hunter.

The Wabash Railroad people, who have always been hampered for water between Springfield, Ill., and Jacksonville, have just completed a new reservoir at New Berlin, in Sangamon county, capable of holding 5,000,000 gallons, have erected a water-tank to hold 30,000 gallons, and have put up a new engine-house and pumping machinery.

ac ific Coast News.

SAN FRANCISCO, Dec. 19, 1885.

Special Correspondence ENGINEERING NEWS.

On December 1st, the first through trains began running from Los Angeles to St. Louis, over the Atlantic and Pacific Railroad. The trains will run over the Southern Pacific to Colton, stopping at all way stations, and at Colton will take the California Southern track connecting at Waterman with the Atlantic and Pacific railroad. Through this arrangement overland passengers will save time, as the fourteen-hour lay over at Mogave will be avoided. The road-bed of the entire Atlantic and Pacific railroad is in a fine condition. The company promises to reduce the time between Los Angeles and Kansas City to three and a half days. It is, however, not yet decided whether Los Angeles or San Diego will be the terminus.

The new blue-print map, issued by the railroad companies, gives Los Angeles a place as a prominent railroad centre. From that point the Los Angeles and Yuma Division of the Southern Pacific stretches northward to Sumner, a distance of 170 miles, and to Lathrop 220 miles farther. The other part of the main line runs from Sumner to Yuma, on the Colorado river, and then to New Orleans. Quite a number of branch lines run through the Los Angeles valley. One branch goes from Los Angeles to Wilmington and San Pedro, the port of entry of Southern California. At Florence, six miles south of Los Angeles, another branch runs easterly to Downey City, Norwalk, Orange, and Santa Anna; it is thirty-five miles long, and bears the name Los Angeles-San Diego railroad. Another branch is known as the Los Angeles-Independence railroad, running from Los Angeles to Monica. The Los Angeles-San Gabriel valley railroad is now finished for a distance of fourteen miles; it will be continued to Colton, a station of the Southern Pacific railroad, and sixty miles distant from Los Angeles. Of late the trains of the Atlantic and Pacific railroad have been running over the California Southern and Southern Pacific tracks from San Diego to Los Angeles via Colton. The Atlantic and Pacific railroad is building an independent track from Riverside station on the California Southern to Los Angeles, to be known as the Riverside Los Angeles railroad. All this shows that Los Angeles will be an important railroad centre.

The Central Pacific R. R. intends to change the structure of the boilers of all their steamboats for the use of petroleum; most of the shop-boilers will also be altered. The large transfer-boat Solano has used petroleum for nearly a year. At present the company uses 140 barrels per day. The oil used is a residual product of illuminating oil and cannot be procured in a pure state from the wells.

The North Pacific Coal R. R. Co. has extended the road from Duncan's Mills to Ingram, a distance of 8 miles. The long rain of last month has delayed the work, but it is expected, that the track will be laid in a month.

As the existing warehouses are not able to accomodate the increasing shipment of grain, a company has been formed, to build a wharf at Berkeley, 2,500 feet long, where deep water is reached. The first 1,500 feet of the wharf will be 30 feet wide, and the remaining distance 100 feet; this latter part will be built of sheet piling, square piles driven closely together. The basin between these piles, 1,000 feet long and 100 feet broad, will be gradually filled in with sand, pumped from either side of the wharf, thus making a solid mole for that distance, with water enough on each side for the largest sized ship to lie and load. On the broad section of the wharf a warehouse 70 feet wide and 1,000 feet long will be built. A double track connecting with the main line of the Central and Southern Pacific R. R. will be laid from the warehouse. A single track will run through the centre of the warehouse, and tracks will also be laid on each side of the same, a space of 15 feet on each side being left for that purpose. The wharf will be run from the foot of Powell Street, Berkeley, which is a short distance north of Shell-Mound Park.

The railroad from Colusa, Colusa county, California, is nearly completed. It is built by local capital and connects the town with the Northern Railway (main line of Central Pacific running north) at a point about five miles north of Williams. Its total length is nearly ten miles and its construction will cost $60,000. All earthwork and trestlework is finished, and the track is now being laid. The road will be opened at Christmas.

Numerous artesian wells have been bored in the southern and recently also in the central and northern counties of California. They are mostly used for irrigation and for watering stock. In Sierra Valley the wells furnish warm water, varying from 50° to 86° in temperature. One well, 832 feet deep, was bored in three days at a cost of $85.00; another discharges 100 gallons a minute, while most of them vary from two to twenty gallons.

The new freight tariff and classification of the Transcontinental Association from California to the East went into effect on December 1st. The classification is made on a different basis than that of the tariff of August 25, 1884, which it supersedes. In the former tariff rates were made on a basis of $6.00 on first-class freight to New York, while the basis of the new tariff is $5.00. The new tariff has nine classes, instead of eight classes as in the old tariff.

The proportional charges between the different points of destination are as follows: $1 per 100 pounds to New York, Boston, Philadelphia, Baltimore, Pittsburg, Cincinnati, Chicago and Milwaukee; ninety-five cents to St. Louis and New Orleans, and eighty-five cents to Omaha, Council Bluffs, Kansas City, Galveston and Houston.

The new tariff is a little lower than that of August 25, 1884, as can be seen by the following comparative table of rates per 100 pounds on a few items to New York, Boston, Philadelphia and Baltimore:

Articles.	Old Tariff.	New Tariff.
Acids, owner's risk	$12.00	$10.00
Acids, carload lots	12.00	10.00
Agricultural implements, reapers, mowers and harvesting machines	5.00	3.00
Asphaltum	2.50	2.00
Asphaltum, carload lots	1.50	1.00
Beef, dressed, prepaired or guaranteed, owner's risk	6.00	5.00
Cigars, well packed	3.00	3.00
Coffins	6.00	4.00
Sash, glazed or unglazed	6.00	3.00
Silk goods	6.00	5.00
Varnish	6.00	5.00
Yarn	6.00	5.00
Bacon	2.50	2.50
Bags and Bagging	3.00	2.50
Beans, carload lots	1.50	1.25

G. J. S.

WATERLOO, Iowa, Dec. 12.—The city council has granted the firm of Dennison & Cowell, of Muscatine, a franchise to build a system of water works in this city. The system is to consist of eight miles of main pipe, and one hundred fire hydrants. The city is to pay an annual rent of $37 per hydrant, which is said to be the lowest rate paid by any city in the United States. The pumps are to have a capacity of three million gallons per day. The direct pressure system is to be used.—St. Paul & Minneapolis *Pioneer Press.*

WATER

THE Lincoln, Ill., City Council, has just closed a contract with Hinds, Moffatt & Co., of Watertown, N. Y., for construction of water-works.

MR. BRUCE'S ordinance, relating to the Monongahela Water-Works Company, at Pittsburg, Pa., has been passed, and the "$3,000,000 ordinance" defeated.

THE fact is finally settled that Janesville, Wis., is to have water-works, a majority of the tax payers of the Bower City being in favor of the movement.

THE Ashland, Neb., Water Works Company has commenced the work of laying 1,700 feet addition section pipe out into the bay.

THE territory from which the Croton water supply is obtained embraces cesspools, barn-yards, 9,445 cows, 1,224 horses, 1,500 pigs and 20 sheep, and a population of 20,000 persons, with their dwellings.

A GENTLEMAN in Eastman suggests that the artesian well be taken up, cut into sections, and sold for post holes, in order to reimburse the town for the money expended upon it.—Eastman (Ga.) *Journal.*

BRIDGEPORT, Conn.—The company formed to introduce to the city public water from Mill river, town of Easton, eight miles distant, will ask the coming Legislature for an act of incorporation authorizing a capital of $1,000,000. The existing company will fight the project.

ON account of the upward tendency of the price of iron the water-works committee of the Milwaukee Common Council has decided to recommend the purchase of 5,000 tons of water pipe at a cost of over $100,000. The pipe will be needed in the spring.

ALL arrangements are made for the water-works at Navasota, Texas, and the business intrusted to the mayor and fire committee, who are negotiating for letting the contract on most favorable terms to responsible parties.

THE Mount Pleasant, Ia., water-works, constructed by George B. Inman, of New York, have now been in operation about two years. The source of supply is a creek about two miles from the city. About seven and a-half miles of pipe have been laid, about one and a-half miles this season.

NEWTON, Mass.—Orders have been passed appropriating $3,500 for water-main extension to Thompsonville to supply that village with water, upon recommendation of the Board of Health, and appropriating $1,000 for the service and meter account in addition to sums already appropriated.

THE iron mains for the new water-works are being delivered. The pump for the mill is in place and by the aid of a small engine, the water is being pumped while the well is being put down. The foundation for the stand pipe is about completed so that by the first of February we will have a water supply from the new water works.—El Dorado, Kan., *Republican.*

BOSTON WATER-WORKS.—Canvass of bids received for cast-iron pipe December 29, 1885.

Quantity	Class	Price per ton of 2,540 pounds.			
		R. D. Wood & Co., Philadelphia.	Warren Foundry & Machine Co., Phillipsburg, N. J.	A. H. McNeal, Burlington, N. J.	Meilert Foundry and Machine Co., Reading, Pa.
25		$29.40			
25 tons.	4" B.	29.40	$30.30	$32.50	$37.00
650 "	6" B.	29.40	29.90	32.00	32.50
270 "	8" B.	29.40	29.90	31.75	32.50
370 "	10" B.	29.40	29.50	31.50	32.50
700 "	12" B.	29.40	29.10	31.00	32.00
100 "	Specials	29.40	52.00	56.00	56.00
		$621.81	64750.50	69140.00	70665.00

Awarded to R. D. Wood & Co.

CHICAGO, Dec. 23.—The town of Lakeview, adjoining Chicago on the north, is in a terrible plight for lack of drinking water. For the past few weeks the people have been suffering a veritable water famine, so severe as to produce a great deal of sickness, which threatens to increase and perhaps result in the spread of some fatal epidemic disease. At the Marine Hospital there has been a great deal of typhoid fever, and the officials attribute it to nothing else than the filthy water pumped through the service pipes. All the cases have developed in the hospital, in which there are now ninety-two patients. The Surgeon General, who has ordered a chemical analysis of the water, declares that it is largely composed of sewage.

THE pumps of the water-works at Fond du Lac, Wis., were set in motion early December 18th. All the artesian wells owned by private parties in this city, about seventy-five in number, have either stopped running or showed a marked diminution in flow since the pumps were attached to the water-works companys' wells. The owners of these private wells are naturally very indignant, and serious complications are likely to follow in matters of law.

THE Eau Claire, Wis., water-works, for the planting of which preliminary work was begun on the 12th of May of this year, have been put in operation. Four pumps are located at the pumping works, having a united capacity of 8,000,000 gallons per twenty-four hour. Twenty-three miles of mains have been laid, with 293 hydrants. About 100 private consumers have had connection made with the works, andare now being supplied. The public test of the works, it is stated, did not quite come up to the general expectation.

THE Middleborough, Mass., water-works have been been constructed under authority of act of the legislature of 1883, by the Middleborough Fire District. The water is taken by means of a large well from the porous gravel beds underlying the meadows adjoining the Nemasket river, in the southerly part of the village. This well has yielded under continuous pumping, a constant supply of not less than 1,200 gallons of water per minute. The plan adopted is that of pumping by steam directly into the distribution piping, to which is attached a compensating reservoir 20 feet in diameter, and 100 feet high, holding 235,000 gallons. When the pumping engine is running, consumers are supplied from that direction, at other times from the reservoir in the opposite direction. Water is admitted to the reservoir at the top and drawn for consumption from the bottom, both operations being effected by a positive automatic arrangement, and causing a vertical circulation of the water, which together with the alternating flow in the distributing pipes ensures fresh water of uniform temperature at all seasons of the year.

The distance from pumping station to reservoir is 8,597 feet, and the total lift is 188 feet.

The static pressure from reservoir at the Four Corners is 62 pounds per square inch; at the Bay State Straw Works, 62 pounds per square inch; at the Star Mills 87 pounds per square inch. These pressures will be increased by the pumping machinery during the test.

The street mains are standard cast-iron, furnished by the Warren Foundry of Phillipsburg, N. J., and laid by Chas. H. Eglee, of Flushing, L. I.

The principal main on Center and Main streets, from which several hydrant streams will be taken, is ten inches in diameter.

The large pressure streams will be taken from a six inch circuit between the Town Hall and the Baptist Church.

The hydrants and stop gates were made by the Ludlow Valve Manufacturing Company, of Troy, N. Y.

The pumping station was built by Q. A. Faunce, of Quincy, Mass., from designs by Ernest N. Boyden, of Boston.

The pumping plant was furnished by the Deane Steam Pump Company, of Holyoke, Mass.

The wrought iron reservoir was built by H. S. Robinson of East Boston.

The well from which the water is taken was constructed by Putterill & Killian of Boston. This well is 25 feet in diameter and 22 feet deep.

The total cost of the works as originally protected is about $70,000.

Engineer, Percy M. Blake.

ST. PAUL'S WATER PUMPS.

The water board met Dec. 15 to consider the report of City Engineer Rundlett. Engineer Harrison of Stillwater and other experts on the test of the water works pumps of the city of St. Paul. This test was made for the purpose of reporting to the board whether they were as guaranteed by the Allis company of Milwaukee. The pumps have never been accepted by the board, and this test was preliminary to an acceptance of them. The small engine was guaranteed to pump 1,500,000 gallons in twenty-four hours, and its capacity was 2,016,320 gallons. The large engine was guaranteed to pump 3,000,000 gallons each twenty-four hours, and its capacity was shown by the test to be 3,615,740 gallons. The duty is the highest ever guaranteed by any manufacturer in America, and while the engines fall a little short of the guaranteed duty, still another test will be made in the spring, when it is expected they will come up to the guarantee. The cost of the engines and boilers was $28,000, of which $14,000 has already been paid, and at the meeting to-day $12,000 more was appropriated toward a settlement, leaving a balance of $2,000, to be paid in the spring if the engines come up to the guaranteed duty.

The report of the experts on the test was as follows:

By the requirements of the specifications, the test of capacity was to be made by river measurement, and the test of duty was to be determined upon the basis of the

actual amount of water pumped, as shown by the capacity test, and the coal used during the trial without any deductions. The conditions of the duty test were that the steam should not exceed eighty pounds, and the piston speed should not exceed two hundred feet per minute, and at the close of the trial the fire, water in the boiler and the steam pressure should be the same as at the commencement. In accordance with these conditions, a proper wier was constructed, and on the night of the 8th of December the test was made of the capacity of the engines. Owing to necessity of working in the night, as the water could not be cut off from the city except at this time without great inconvenience, the river test was made under some disadvantages. Every proper precaution was taken, and we believe the results obtained are accurate. The 3,000,000 gallon engine was run two hours and the 1,500,000 engine was run one hour, an alarm of fire necessitating a stop at this time. The area of plunger of 3,000,000 engine is 261.96 square inches, and the length of stroke 30 inches. The area of plunger of 1,500,000 engine is 153.58 square inches and the length of stroke 24 inches. From the measurement we find that the slip, or loss, of the 3,000,000 gallon engine is 2.5 per cent. of the plunger displacement, and the slip of the 1,500,000 gallon is 4.8 per cent. In testing the duties of these engines each engine was run ten hours under a water pressure equivalent to the static head of 150 feet, plus the friction in pipe. The record for the 1,000,000 gallon engine is as follows:

Total number of revolutions	22,141
Displacement at each revolution, gallons	68,044
Total number of gallons pumped	1,506,562
Average water pressure, pounds	66.07
Temperature of water, degree	38
Weight per gallon, pounds	8.345
Total number of pounds raised one foot	5,081,500,000
Total amount of coal used, pounds	2,216
Giving a duty of, ft. pounds,	93,929,000
Less 25 per cent slip, ft. pounds,	2,348,000
Corrected duty, ft. pounds,	91,581,000
Capacity in hours, ft. pounds	3,615,740
Piston speed, feet per minute	184.5
Duty required, ft. pounds	95,000,00

The record for the million-and-a-half engine is as follows:

Total number of revolutions	27,583
Displacement at each revolution, gallons	31,969
Total number of gallons pumped	881,800
Average water pressure, pounds	69.11
Temperature of water, degrees	38
Weight per gallon, pounds	8.345
Total number of pounds raised one foot	1,174,729,000
Total amount of coal used, pounds	1,293
Giving a duty of, ft. pounds	90 353 000
Less 4.8 per cent slip, ft. pounds	4,361,000
Corrected duty, ft. pounds	86,492.00
Capacity in 24 hours, gallons	2,016,320
Piston speed, ft. per minute	183.9
Duty required, ft. pounds,	95 000 000

We would also add that the general working of the pumping engines was satisfactory. The cards taken from both engines were excellent. All the parts moved smoothly and well, and the whole machinery shows careful workmanship and correct adjustment.

NEWS OF THE WEEK.

CONTRACTING.

There is no single class journal in the United States read by so many contractors for all kinds of Civil Engineering construction as ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL. *We propose as in the past to publish early intelligence of all new contract work. Our prices for advertising proposals for contracts is twenty cents per line, and it is so cheap that parties having any work to advertise will always find it a good investment to use this journal.*

Burlington & Missouri R. R.—The B. & M. surveyors are at work on a line from Edgar, Clay Co., Nebraska, south via Nelson, the countyseat of Nuckolls Co. Some of the precincts voted on a bond proposition for the Mo. Pacific to build from Warwick, Kan., to Nelson, on the 26th of December.

Water Works Plant.—The St. Louis house of the Henry R. Worthington Hydraulic Works have been awarded the contract for supplying the city of Dallas, Tex., with a complete water works plant. Two pumping engines, each of a daily capacity of 3,000,000 gallons, and three 60-horse power boilers will be required, including all piping and details whatever to make a complete pumping plant.

Submerged Pipe.—Proposals will be received by J. W. Henion, Superintendent Board of Water Commissioners, Minneapolis, up to noon of the 7th inst., for furnishing 828 feet of 24 inch flexible joint cast-iron water pipe, and for dredging, caulking and putting the same in place across the Mississippi river near Twentieth avenue north, in the city of Minneapolis, Minn. Separate proposals will be received for the pipe and the dredging, etc.

The Midland R. R.—The contractors Prisco and Fiorella are pushing this road as fast as circumstances will permit. There has been a delay for want of material, but fifty-five car loads of steel rails were received last week at Westfield, Ind., and the contractors say they can complete the line in ninety days.

Iron Highway Bridges.—Proposals for two iron highway bridges with the necessary abutments, piers and approaches at two separate crossings of the Grand River, in Mesa Co., Colorado, to cost about $38,000 each, will be received until January 25th, at the office of E. S. Nettleton, State Engineer, and Member of the Bridge Board, at Denver, Colorado. Specifications and particulars can be had on application.

Trouble with the Philadelphia Sewer.—R. Malone & Sons, the contractors, intended unloading the pipes which are to be laid at the bottom of the canal of the Schuylkill Navigation Co. on the tow-path of that canal, but the Company applied to the city, and after some time during which a fight seemed imminent between the employes of the contractors and the canal company, the scow containing the pipes was withdrawn. It is reported that the Navigation Company has ordered a lot of barges and lighters to be placed in the canal, so as to choke it up during the winter and stop the city from putting the sewer in its bed.

Street Paving.—A well paved road has just been finished at Chattanooga, Tenn.; it is 3 miles long and 30 feet between curbs; its cross-section is an arc with a rise of 1 in 30 from curb to centre, and is covered with 15 inches of stone at centre and 12 inches at the gutter. After the sub-grade had been well rolled with 15-ton steam rollers, a layer of uncrushed stone was laid down, the stones being 8 inches deep at the centre and 6 inches at the gutter, and laid flatwise. On this was placed a 4-inch layer of screened quarry waste and tailings rolled with the steam roller. On this was placed a 3-inch layer of stone passed through a 2-inch rotary screw, all of uniform size. It is the idea that only this top layer will ever need repairing, the foundation being carefully made with a view to stability and drainage. The gutters are laid with 6-inch sets. According to the Chatanooga *Times*, one mile of street, 36 feet wide, can be paved and finished as above for $11,000, and, when so finished $5,00 will keep it in good repair for ten years.

St. Louis Street Paving Bids.—Lowest bids received for re-construction of streets with granite, on November 24th, 1885.

Letting No.	Base per cubic yd.	Quantity, cubic yards.	Pavement per square yard.	Quantity, square yards.	
1631	$4.03	327	$2.56	1455	MEMORANDUM.—The base consists of hydraulic cement concrete 8 inches deep, laid complete. The pavement consists of granite blocks 8 ins. deep, laid on 2 inches of sand, including cementing the joints with hot bitumen and gravel, complete.
1632	4.03	570	2.56	2533	
1633	4.03	670	2.56	2977	
1634	4.03	173	2.56	767	
1635	4.03	170	2.56	755	
1636	3.02	1308	2.85	5811	
1637	3.22	555	2.70	2466	
1638	4.03	1828	2.56	8121	
1639	3.02	875	2.84	3889	
1640	3.02	1325	2.87	5888	
1641	3.22	945	2.85	4200	
1642	3.02	1447	2.87	6399	
1643	3.02	1905	2.81	8466	

Railroads, Bridges and Canals.

The Aqueduct Slaughterhouse.—The thirty-seventh victim of the new aqueduct has met his death at Shaft No. 7.

The Chicago & Great Southern R. R. people complete their road as they advance with the work; even the telegraph poles are erected and the wires strung as fast as the track is laid.

Office Abolished.—The office of Superintendent of Bridges on the Queen and Crescent route was abolished on Jan. 1.

The Union Pacific R. R. is building five branch lines, aggregating in length 187 miles, and ways and means are being considered for constructing from 200 to 300 additional miles in Nebraska and Kansas.

The Canadian Pacific R. R. Company now asks of the Dominion $10,000,000 more to enable it to finish its great scheme of a railway extending from the Atlantic ocean at Halifax across to the Pacific, thus making it the most comprehensive "railway monopoly" in the world.

The Mexican Central Railroad Company, in a circular announcing its inability to meet the interest on its first-mortgage bonds, holds out the hope that the government will resume the payment of subsidies. The company has on hand $5,000,000 in unpledged subsidy certificates.

New York, Susquehanna & Western R. R.—A company has been organized to build a branch from the N. Y. S. & W. R. R. at Charlotteburg, Passaic county, N. Y., to Port Oram, Morris county, a distance of fourteen miles. Ex-senator Garret A. Hobart, of Paterson, N. J., and Ex-Judge Low of Orange county, N. Y., are among those interested.

A New Florida Line.—Articles of association have been prepared, and a temporary board of directors named, and the organization of the Leesburg, Esmeralda and Lake George Railway Company, will be effected as soon as it can be done. Meanwhile a preliminary survey of the route will be made.

An Extension—CADILLAC, Mich., Dec. 23.—At public meeting of the citizens and Common Council a contract was signed with the Toledo, Ann Arbor & Northern Michigan Railway Company providing for the extension of the latter's road from its present terminus at Mount Pleasant to this place on or before Jan. 1, 1887. The city's bonds for $35,000, as voted at last spring's election, will be immediately deposited with the Fourth National Bank of New York City in escrow, the conditions being the performance of the above contract.

A Mining Region to be Developed.—Two prominent capitalists in the Northwest Messrs. Broadwater of Montana and Wilder of St. Paul, are in Boston negotiating for means to build a railroad from Helena, Montana, to the Red Mountain mining district, a distance of about twenty-five miles. The Red Mountain is an undeveloped iron and coal field. The road will connect with the Northern Pacific at Helena. About $1,000,000 has already been raised toward the construction.

Canadian Projects.—Next year the upper peninsula will revel in railroads if those now upon paper are really built. The Canadian Pacific R. R. proposes to build an eighty mile spur to the Sault; the Detroit, Mackinac, & Marquette R. R. will construct forty-six miles to meet the Canadian Pacific extension at Sault Ste. Marie; the Milwaukee, Lake Shore & Western R. R. will build a line fifteen miles north and east from Watersmeet, which, in the future, will be extended to the Republic iron mine, and the Minneapolis & Sault Ste. Marie R. R., will be extended to Rhinelander.

The B. & O. R. R.—The negotiations between the B. & O. and the Pennsylvania Midland railroad have been declared off. The first-named company was trying to purchase the latter. As the B. & O. needs additional mileage to place their bonds for the construction of the East Side railroad, a charter has been secured by that company for a line between Philadelphia and Chester, Pa., via Newtown Square. The line is being located under the leadership of Mr. Irwin, who has his headquarters at West Chester, Pa. He proposes to run south of the line located by the P. M. R. R. He has made West Chester his starting point, and will run east.

The Fort Mason, Seneca and St. John's River Railroad Company has been organized, and the following officers chosen: R. McS. Byrne, Fort Mason, president; W. S. Burdett, secretary and treasurer; J. C. Bryson, Orlando, Ivy Royal, Cassia, G. W. Bowen, Eldorado; W. Bramhall, Seneca, J. T. Wofford; R. McS Byrne, Fort Mason, W. W. Hicks, Eustis Meadows, directors; E. H. Rohrer, Eustis, civil engineer; W. B. Owen, Jacksonville, Attorney. Subscriptions to the amount of $28,000 have already been obtained. The line is surveyed, starting at Fort Mason and running through Eustis Eeadows to Eldorado, Seneca and Philipsburg to the St. John's river near Hawkinsville Fla.

Kentucky Railroads—The total number of miles of railroads in the state is 2,051, and the increased mileage for the last two years, 191. There are four projected roads in the state actually under construction. The Chesapeake and Nashville, designed to connect the Chesapeake and Ohio with Nashville; the Clarksville and Princeton, the Henderson and Union county capitalists' enterprise, for a road from Henderson down the Ohio river to Morganfield, and thence across the state to Jackson, Tenn., making the shortest and most direct route from Chicago to New Orleans and Mobile to connect the Bluegrass with the coal, iron and timber region of Eastern Kentucky.

Wabash R. R. Improvements.—The engineers, by the aid of divers, have completed the preliminary surveys at the bridge over the Mississippi at Hannibal, with a view to putting in a new superstructure. The present bridge is perfectly sound, but is of lighter construction than the traffic which it is intended to throw on this line will require, especially as a heavier class of locomotives are to be used than the bridge was calculated for. The work will be done without interruption to traffic. Surveys have been completed for widening the road-bed at the heavy fill in the sharp curve just east of Decatur, on the Chicago Division. This work will be 1,200 feet in length, and will contain over 10,000 cubic feet of earth.

Progress Record of Tunnels on the South Penna. R. R. From Commencement to Ending of Work.

Compiled from the Official Reports of the Division Engineers.

Date of Report.	Time. Weeks.	Blue Mt. 4,240 feet.				Kittatinny. 4,520 feet.				Tuscarora. 5,225 feet.				Sideling Hill. 6,662 feet.				Ray's Hill. 3,534 feet.				Allegheny. 5,919 feet.				Negro Mt. 1,100 feet.				Quemahoning. 700 feet.				Laurel Hill. 5,389 feet.			
		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.		Head.		Bttm.	
		W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.	W.	E.
1884.																																			
March 29	5	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	102	....	....	....	....	....	....	....	....	....	....	....	....	....
May 3	5	....	....	....	....	....	105	....	....	....	....	....	....	....	....	....	....	....	....	....	....	43	181	....	186	....	....	....	....	....	....	....	....	....	....	....	....
May 31	4	....	....	....	....	27	148	....	52	....	....	....	....	....	5	....	....	59	79	....	....	139	242	....	131	....	....	....	....	....	....	....	....	....	....	....	....
June 28	4	....	98	....	....	118	197	76	118	88	148	....	....	32	35	....	....	148	125	....	....	171	328	85	287	....	....	....	....	....	....	....	....	28	127	....	....
Aug. 2	5	....	258	....	45	254	312	196	255	247	226	....	15	95	147	....	68	268	234	....	....	256	490	267	412	....	....	....	....	....	....	....	....	116	219	....	....
Aug. 30	4	....	336	....	190	392	412	306	350	316	382	15	64	195	275	100	125	250	272	....	75	355	652	276	469	....	....	....	....	....	....	....	....	263	394	....	....
Sep. 27	4	63	481	....	126	520	510	466	463	355	550	31	243	238	351	136	182	336	272	144	240	449	796	363	536	....	....	....	....	....	....	....	....	370	396	18	....
Nov. 1	5	174	701	80	318	704	672	654	620	529	651	168	425	325	548	247	319	397	346	245	314	699	855	523	749	....	....	....	....	....	....	....	....	423	396	94	....
Nov. 29	4	226	888	160	492	827	790	793	742	687	762	248	630	432	665	327	414	472	439	333	377	854	974	685	857	....	....	....	....	....	....	....	....	488	396	148	....
Dec. 27	4	305	1052	217	644	956	920	910	846	793	876	353	793	577	759	383	509	513	500	397	453	916	1088	801	945	....	....	....	....	....	....	....	....	488	396	288	8
1885.																																			
Jan. 31	5	421	1186	310	854	1103	1098	1058	1020	915	978	628	918	721	870	488	679	601	586	511	546	981	1169	981	1156	....	79	23	....	....	....	....	....	552	396	525	24
Feb. 28	4	494	1186	375	1090	1223	1279	1166	1173	1014	1130	823	1016	757	1019	707	855	694	637	550	596	1106	1311	1079	1285	....	155	85	....	....	....	....	....	693	396	654	60
March 28	4	632	1296	498	1251	1316	1352	1250	1345	1090	1281	1030	1185	913	1158	893	1004	790	734	664	695	1245	1450	1189	1400	....	246	152	....	....	....	....	....	807	396	780	104
May 2	5	780	1416	692	1365	1443	1705	1580	1585	1217	1503	1185	1395	1125	1260	1097	1097	939	869	811	819	1442	1555	1466	1480	....	318	268	....	....	....	....	....	889	396	818	110
May 30	4	938	1506	825	1453	1537	1875	1462	1750	1350	1643	1222	1535	1259	1412	1239	1255	1021	989	811	944	1629	1708	1462	1560	....	432	376	255	....	....	....	....	889	396	848	110
June 27	4	1080	1593	1008	1547	1604	1982	1542	1875	1520	1737	1345	1643	1389	1556	1363	1420	1052	1070	858	1055	1838	1925	1730	1760	....	506	489	339	....	89	....	....	889	396	848	110
Aug. 1	5	1162	1750	1123	1700	1663	2088	1614	2014	1677	1848	1564	1733	1513	1689	1473	1576	1052	1167	1007	1280	1913	2033	1771	1690	45	506	544	339	54	251	....	....	889	396	848	110
Aug. 29	4	1188	1836	1168	1793	1675	2278	1632	2165	1754	1875	1685	1834	1577	1689	1562	1654	1110	1254	1084	1286	1913	2033	1780	1721	45	636	502	339	73	281	....	....	889	396	848	110
Sept. 26	4	1188	1870	1168	1840	1675	2350	1632	2310	1799	1939	1753	1910	1577	1699	1562	1685	1173	1304	1140	1334	1913	2033	1780	1721	45	651	647	339	73	313	....	....	889	396	848	110
Oct. 17	3	1188	1875	1168	1846	1675	2382	1632	2340	1806	1950	1777	1933	1577	1699	1562	1685	1178	1317	1153	1334	1913	2033	1780	1721	45	689	647	339	73	313	....	....	889	396	848	110

NOTE.—The report above gives the total progress in feet for the heading and bottom, at the east and west end of each tunnel for the date given. The progress made in the four or five weeks covered by the report is found by deducting from any one item the lineal feet of the previous reports in same column.

A Boston "L" R. R.—An electric elevated road is proposed to run from Boston through the Charlestown district and Somerville to Medford. The scheme is in favor in the district.

The Pensacola, Ness City and Puget Sound Broad Gauge Double Track Railway Company is the name of a new wildcat road which has been incorporated in Kansas.

The Yazoo and Mississippi Valley Railroad is being pushed vigorously. The contractors are now getting out ties for twenty-nine miles of road. The head-quarters camp is nine miles north of Yazoo City.

A New Line in the Slate Region.—EASTON, Pa., Dec. 26.—The Martin's Creek railroad, a short line crossing the Delaware at Martin's creek, and running up the valley to join the Bangor and Portland Railroad was completed to-day.

Georgia Midland & Gulf R. R.—The preliminary survey of this road was completed on December, 19th. Major Greene, the engineer in chief, says he cannot tell when the work of locating the route will begin as the directors will have to decide that matter.

Nashville & Chattanooga R R.—The survey has been completed for the extension of the Fayetteville branch of the Nashville and Chattanooga road from Elora, Tenn., to Huntsville, Ala., a distance of twenty-five miles. The road will be built under the name of the Nashville and North Alabama Railroad.

Arkansas Extension.—The building of the extension of the Swan Lake and Pine Bluff Railroad to Argenta, opposite Little Rock, is progressing rapidly, There are 120 laborers at work, and by the 1st of January the road, starting from Rob Roy, will reach a point opposite Pine Bluff and Bells' Ferry, five miles above there. A transfer boat will be launched at or near Pine Bluff city wharf.

Henderson's New Road.—The road being built from Henderson to Jackson, Ky., has been graded for 25 miles. Two thousand tons of steel rails have been delivered to the contractors, who are proceeding rapidly with the work. It is expected to have the line through by the early part of 1887. The most costly part of the work will be the bridging of the Cumberland and Tennessee rivers.

Work in Alabama.—An engineer corps is being organized to make a survey of the extension of the East and West Railroad from Broken Arrow to Birmingham, Ala. The road is a narrow gauge, and now runs from Cartersville to Broken Arrow, a distance of about 135 miles. When the extension is completed Rome will have through connection with Birmingham, by way of Rome and Carrollton and the East and West Railroad.

A New Canadian Railroad.—The last spike on the Northern and Pacific Junction Railway has been driven this week. This road, which is a continuation of the Northern and Northwestern Railway, is 111 miles in length, and connects with the Canadian Pacific Railway at Callendar. By this route Toronto and western Ontario will be brought nearly 214 miles nearer to Winnipeg and the Northwest. It is expected the road will be ready for traffic in February.

South Penna. R. R. Tunnels.

Concluded from page 371.

Explosives used per lin. ft. derived from reports made by Div. Engineers S. P. R. R. in summer of 1885 in "Methods of Tunnel Excavation." Fannettsburg, Pa., Oct. 1885.

Locality		Nature of Rock	Dip of Rock	Prescribed Exc. per lin. ft. in yards		Explosives used per lin. ft. in lbs. (Dynamite and Rackarock Giant Powder.)	
				Head.	Bench.	Head.	Bench.
Blue Mt.,	East	Hard Red S. S.	Vertical.	3.1	7.6	31. of 40% D	17 of 40% D
"	West	Soft "Olive" Shale.	80° L.	6.	10.	19. "	6.6 "
Kittatinny "	East	Hard " "	30° L.	3.2	7.5	24. 36%	15.3 35%
" "	West	" Red S. S.	Vertical.	3.5	7.2	33. 60%	17. 60%
Tuscarora "	East	Medium hard black shale.	70° R.	3.2	7.5	18. 40%	11.4 40%
" "	West	" " "	60° R.	3.2	7.5	19. 40%	16.3 40%
Sideling Hill	East	S. Stone and Slate.	Horizontal.	6.4	9.8	28.5 Rk. Rk	9.6 Rk. k.
" "	West	" "	67° L.	3.2	7.5	7.4 40% / 8.36 Rk. Rk	12. 40%
Rays "	East	Hard Gray S. S.	70° R.	2.5	8.2	25. 60%	15.5 60%
" "	West	" " "	70° L.	2.5	8.2	51. 50% / 16. 40%	5. 50% / 81. 40%
Allegheny Mt.	East	Red Shale.	10° R.	2.8	11.3	17. 40%	13. 40%
" "	West	" "	10° L.	2.8	11.3	17. 40%	13. 40%
Negro "	East	Hard Grey Slate.	Horizontal.	3.0	7.7	14. 40%	14. 40%
Quemahoning "	West	Soft " "	"	6.25	10.0	13.5 Giant P.	11. 40%
Laurel Hill "	East	Gravel.					
" " "	West	Limestone.	Horizontal.		8.	17.5 45%	15. "

W. H. ATWOOD, Div. Eng., Div. II.

Estimate of the amount of explosives equivalent to 40% dynamite, used *per cubic yard* of prescribed excavation at the various tunnel ends. Div. No. 2 S. P. R. R. as derived partially from observations made in 1885, as to "Methods of Tunneling." Fannettsburg, Oct. 1885.

Kind of Rock.	Locality & Ydge. prescribed per lin. ft.		Heading. Pounds.	Yardage per ft.	lbs.	Yardage per ft
"Hudson River" Shale without mixture with sandstone.	26 yards	W. Kitty. / E. Tusca. / E. Blue.	5.5 lbs. up to 3.5 yards per lin. ft. and 2 lbs. per balance.	7.	1.2	19.
	19.5 "	E. Tusca. / W. Kitty.	Same as above.	7.	0.9	19.
	14.0 and 16.0 yards	E. Tusca.	"	7.	1.3	19.
				4.7	1.05	14.8
				4.7	1.35	14.8
				5.5	1.2	10.0
"Hudson River" Shale within 300 ft. of "Oneida Sandstone" with mixture of sandstone, increasing to all sandstone next to "Oneida."	19.5 yards	W. Kitty. / E. Blue.	6.0 lbs. up to 3.5 yards per ft. and 2.5 lbs for balance.	4.7	1.45	14.8
	10.7 "	E. Tusca.	6.	4.7	1.45	14.8
				3.2	1.52	7.5
"Olive Shale" and all other rock in West Tusca. to date except "Ore Sandstone."	30.0 yards	W. Blue.	2.	9.	0.5	21.
	26.0 "	W. Tusca.	5.5 lbs. up to 3.5 yards per lin. ft. and 2 lbs. per balance.	7.	1.0	19.
	26.0 "	E. Kitty.	4 lbs. for 4 yards advance heading 2 lbs. per balance.	7.	1.35	19.
	19.5 "	E. Kitty.		4.7	1.45	14.8
	16.0 "	W. Blue.		6.	0.7	10.
(All Clinton formation.)	10.7 "	E. Kitty.	7.3	3.2	1.9	7.5
	10.7 "	W. Blue.	4.8	3.2	1.85	7.5
	10.7 "	W. Tusca.	6.3	3.2	2.17	7.5
Red and Grey Sandstone.	10.7 yards	E. Blue.	10.	3.1	2.2	7.6
	10.7 "	W. Kitty.	14.	3.5	3.5	7.2
Red Medina and Grey Oneida.)	10.7 "	E. Tusca.	10.	3.2	2.0	7.5

A Dakota Scheme.—A movement is on foot to build a railroad from Bismarck northwest. It is understood that unless the Milwaukee & St. Paul or the Northwestern pushes into the country within this present year an independent company will be organized to build southeast and pool with the Rock Island, which is headed for this point.

Shakespeare and Tunnels.—The tunnel under the river Mersey is to be opened next month. Those who dug this marvelous hole in the ground are gratified because there is no sign so far of a leak. In other words, as a paraphrasing wag puts it, "the quality of Mersey" has not yet strained through.—Philadelphia *Press.*

Market Report of Engineering Materials.

New York, December 31, 1885.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.95	@	2.00
Tee	2.25	@	2.35
Beams and channels American	3.0c.	@	
Tank	2.	@	2.1c
Shell	2.4c.	@	2.5c
Steel plates, Tank	2½c.	@	
WROUGHT-IRON PIPE.. PITTSBURGH.			
Butt welded, black ..Discount	42½	@	45
" " galvanized "	32½	@	35
Lap welded black "	60	@	62½
" Galvanized "	45	@	42½
Boiler tubes "	55		
RAILS.			
Steel (large lots at mill)	35.00	@	35.50
Old rails	21.00	@	22.00
Old rail steel	19.00	@	20.00
R R. spikes	2.25		
R R. splice-plates	1.70	@	1.75
R R. Track Bolts Square Nuts	2.75		
Barb-wire fencing, galvanized			4.75
" painted			3.75
Corrugated iron			
Nails			
Iron, per keg	2.65	@	2.75
Steel do.	2.50		

METALS.

COPPER.			
Lake Superior			11.50
Other Brands	10.50	@	11.00
LEAD.			
Com. Domestic	4.60		4.65
Lead Pipe	.06¼		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.07¼		
ZINC.			
Sheet	5.20	@	5.50

BRICK.

Cargoes afloat)			
Haverstraw per M.	$6.50	@	6.75
Fishkill			
Up-River	6.25	@	6.50
Jerseys	5.50	@	6.00
Long Island			
" pale	3.00	@	3.50
FRONTS.			
Croton, red	11.00	@	14.00
" dark	11.00	@	14.00
" brown	10.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	24.50	@	25.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@	$3.00
BAETJER & MEYERSTEIN:			
Hanover Portland	2.60	@	2.65
BELLONI & Co.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S.	2.55	@	3.00
BROOKS, SHOOBRIDGE & Co.	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs.	2.65	@	2.90
K. B. & S. " "	2.75	@	2.95
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fieve, A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, ERSKINE W.:			
Stettin (German) Portland Cement	$2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT Co. Rosendale			1. 0
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.40
LAWRENCE CEMENT Co.:			
Hoffman Rosendale			
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & Co.:			
J. B. White & Bros. Coarse	4.50	@	5.00
" Fine	8.00	@	10.00
" Portland	2.45	@	2.85
NEW YORK CEMENT Co.:			
Rosendale			1.20
N. Y. & ROSENDALE CEMENT Co.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BABSON:			
K. B. & S.	2 35	@	2.60
STANDARD CEMENT Co.			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT Co.:			
Windsor	1.00	@	1.10
Standard			1.15
Cable's Portland	2.15	@	2.40
UNION AKRON CEMENT Co.:			
Akron "Star" brand			

ASPHALT.

Prices range per ton	$15.00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			

LIME.

Rockland, common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	95	@	1.00
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.90	@	0.95
" " No. 2 "	0.75	@	0.80
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " "	0.75		
Brown stone, Portland, Ct. "	1.00	@	1.30
" Belleville, N. J. "	0.75	@	1.25
Granite, rough	0.60	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
Choice "	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd. each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2½ × 4 to 4 × 6 in	.16	@	.44
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30,00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "			2.30

PAINT.

Lead, white, American dry per lb	.04¾	@	.05
" " " in oil pure "	.05½	@	.06
English, B. B. in oil "	.08½	@	.08¾
Red, American "	.05¼	@	.05½
Litharge "	.05	@	.05½
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.11	@	.11¼
Paris green "	.15	@	.20
Umber, Amer. raw and powdered per lb.	.01¼	@	.01¾
Drop black, Amer. "	.07	@	.13
" " Eng. "	.11	@	.13
Chrome green "	.05	@	20
Oxide zinc, American "	.03¼	@	.04
" French "	.06¼	@	.08

THE Laclede Rolling Mills, St. Louis, have started three more puddling furnaces.

THE second stack of the Saucon Furnace, at Hellertown, Pa., will be blown in soon.

WORK has been resumed at the Sharpsville, Pa., iron furnace, which has been lying idle for two years.

THE Bellaire, Ohio, Nail Works, which have been running steadily for several months, will close down after the holidays for an indefinite period.

IT is announced that the Western Steel Company, lessees of the Vulcan Steel Works, St. Louis, Mo., will start up their rail mill.

The reorganization of the St. Louis Ore & Steel Co. will probably soon take place. This will take it out of the receivers hands.

WORK has been resumed at the Hope Mill of the Pottstown Iron Company, in Pottstown, Pa. The mill has been idle for several months.

THE mines of the Pennsylvania Coal Co. at Pittston have closed for an indefinite period, throwing over 1,000 men and boys out of employment.

THE Cuyahoga Rolling Mill Co. has leased the Cleveland Crucible Steel Works, at Cleveland, Ohio, and expects to be in operation shortly.

THE new 7-ton open-hearth furnace of Emerson Hammond & Orr, Pittsburg, will be ready for work this month.

THE *Mining News* of Florence, Mich., reports that the new furnace of the Iron River Furnace Co. will go into blast within a month.

THE Coshocton, Ohio, Iron and Steel Works have shut down, throwing about 100 men out of employment. The cause given is the inability to do work at the prevailing prices.

THE Lackawanna Iron and Coal Company have informed their employees in Scranton, Pa., that on January 1 their wages will be restored to the figures prevailing six months ago, when a reduction of about 15 per cent. was made.

THERE is no better index by which to judge of the probabilities of trade than the condition of the iron industry. Iron enters to such an extent into construction, that the prospect of fair business in iron manufacture means fair general business. It means a large number of men directly employed, and the indirect employment of several times as many more, which brings about quick and healthy circulation of money, that moves the wheels all along the line. In this view of the case, in which all will agree, those who grow timid over a slackness of trade (otherwise than in special lines) always incident to the holiday season, may take courage from the fair prospects of iron manufacturers for the year 1886. Contracts ahead will cover from 15 per cent. to 20 per cent. of the total output of 1884, and, as is well known, owing to unsettled conditions, consumers have for many months bought only for immediate use. Under these circumstances, the fact that so many furnaces will begin the work of the new year with large orders on their books is pleasingly suggestive. After the 1st of January, unless all signs fail, general business will feel the better prospects of the iron trade in the shape of healthy and conservative progress. As the year progresses, new demands will spring up in the way of renewals and repairs, which have been neglected for two or three years; this means a call for more iron and more work. Government is likely soon to be in the market for iron: in fact, everything points to prospects of a fairly good year for iron manufacturers, and by this the prospects of other business and trades may be safely gauged. We congratulate every one on the excellent outlook for the iron makers.—*American Machinist*,

LINES BUILT DURING THE YEAR.—CHICAGO, December 30th.—In its issue for to-morrow, the *Railway Age* will say: "When the year 1885 opened very little was expected of it in the way of railway building. The record for the year as we now present it, shows that this assumption was far from being correct, and that while the extent of new mileage added is less than in 1884 and very much less than in several previous years, it is by no means insignificant. The total length of main line, not including second track, sidings or renewals, laid in the United States during 1885, was 3,113 miles. This is about 700 miles less than the new mileage of 1884, and it is less than in any year since 1878, when the total was but 2,687 miles, while in 1875 the record of new constructions reached only 1,711 miles. The new track laid this year is distributed as follows: New England states, 4 lines, 13.5 miles; Eastern and Middle states, 26 lines, 281.9 miles; Middle and Western states, 31 lines, 464 miles; Southern states, 44 lines, 727.4 miles; Missouri belt, 21 lines, 542.5 miles; Kansas belt, 24 lines, 828.6 miles; Colorado belt, 2 lines, 14 miles; Pacific belt, 14 lines, 240.9 miles; total in 34 of the 47 states and Territories, 166 lines, 3,112.8 miles. The work done has been largely on branches and extensions of moderate length, and has not included any very large lines, such as in previous years have helped greatly to swell the total. In New England and the East almost no new track has been added. The principal activity has been in the Southern states and in the belt between the Missouri River and the Pacific states and Territories."

"ALTHOUGH complete statistics are not in, it is certain that we made almost as much pig iron and as many steel rails in 1885 as in 1884. The first half of 1885 showed greater depression in these branches and in other branches than in any other six months since the recent period of depression began, and, of course, with restricted consumption and falling prices, production fell off. In the first half of 1885 the total production of pig iron was 2,150,816 net tons of 2,000 pounds, against 2,267,021 tons in the first half of 1884, and 2,322,592 tons in the second half. The production of Bessemer steel rails in the first half of 1885 was 452,146 net tons, against 593,370 tons in the first half of 1884, and 523,251 tons in the last half. Our production of pig iron in 1884 was 4,589,613 net tons, and our production of Bessemer steel rails was 1,116,621 net tons. Stocks of pig iron at the close of 1884 aggregated 593,000 net tons. At the close of 1885 there was certainly no increase, and there was probably a slight decrease.

Railroad building in 1885 was more active than it had generally been supposed that it would be. In 1884 we built 3,950 miles of new railroad, and in 1885 we built over 3,000 miles, which is 500 miles above estimates for the year that were made as late as July. We shall do better in 1886.

The European iron trade exhibited no symptoms of a revival in 1885, but, on the contrary, the backward movement which has from the first more than kept even pace with our own depression, continued until the close of the year. Taking the iron-making countries of Europe as a whole, the iron trade situation in that grand division is much worse to-day than it was six months ago."—*Journal Iron and Steel Association.*

Armor Material in Europe.*

Official Report to the U. S. War Department.

BY WM. H. BIXBY, CAPT. OF ENGINEERS U.S.A.

Armor.

Up to within a few years, wrought-iron was the only material available for use as armor against heavy projectiles.

The armor materials which have lately sprung into prominence are steel-faced wrought-iron, surface-hardened (or chilled) steel, and chilled (or surface-hardened) cast-iron. At the present date, heavy armor (from 12 inches to 40 inches thick) is very expensive; its cost, firmly mounted in place, being approximately as follows:—wrought-iron, from $200.00 to $350.00 per ton; steel-faced wrought-iron, or surface-hardened-steel, from $400.00 to $600.00 per ton; chilled-cast-iron, from $150.00 to $200.00 per ton.

The whole subject of armor is too extensive to be properly treated in such a report as this; moreover it has already been quite thoroughly treated in detail, discussed and summarized by many competent writers, who have published their works in pamphlets or periodicals already in the U. S. Engineer Department Library or in other Libraries easily consulted. In consequence, the writer will limit himself here to a condensed treatment of the subject and to references to printed works where the whole subject can be studied in detail; and he will present here in full only such material as has not yet been published in English.

The history of wrought-iron and steel-armor and its trials from its commencement up to 1865, has been quite thoroughly treated by Holley (1); and up to 1873 by Glanz (2); and from about 1865 up to the present day (end of 1883) by Col. Inglis, R. E., in almost yearly reviews (3). All new experiments are almost always described at once by Captain Orde-Browne in the current files of the London Engineers.

Relative Advantages.—Taking into consideration the cost of bolts, bolt holes, and other means of assemblage, and the cost of fitting and setting up of armor, the same amount of money will, roughly speaking, furnish a steel-faced wrought-iron or surface-hardened-steel armor of 20 inches thickness, a wrought-iron armor of 40 inches thickness, or a chilled cast-iron armor of 60 inches thickness. Roughly speaking the steel-faced wrought-iron or surface-hardened steel is least heavy, and the strongest in proportion to its thickness; the wrought-iron is easier made, easier worked, easier added to, best against racking shots, localizes best the effect of a shot, can best be penetrated and even perforated without being actually destroyed, and can best have the amount of penetration calculated in advance; the chilled-cast-iron is easiest and quickest made, can be given any shape, requires the least working, is easiest and quickest placed in position, is never penetrated, always shivers to pieces the striking projectiles, generalizes best the effect of a striking projectile, provides the greatest weight or mass to receive the total living force of the striking projectile, has no bolts to be knocked off on its interior, and sends off the fewest splinters on its interior. The steel has undoubtedly the advantage around the edge of embrazures and wherever thickness or weight is undesirable or inadmissible, also wherever it can be backed by a great thickness of less expensive masonry; the chilled-cast-iron has undoubtedly the advantage where a case of emergency (such as an imminent war) demands rapid construction, where curved shapes are preferable (the cupola turret exposing only 0.5 as much surface as a cylindrical turret to projectiles striking it with an angle of incidence of from 90 to 45 degrees), where masonry or other similar rigid backing cannot be used, and wherever weight or mass is an advantage (as must be the case when a single plate is liable to be called upon to receive a single blow of 40,000 foot tons).

The loss of living force due to the splintering, or change of shape and heating of the plate, may vary from 10 per cent. to 50 per cent. of the total living force of the striking projectile (3).

Against penetration, the strength of several equal thicknesses of iron placed in contact with each other and securely fastened together, is about equal to that of each single thickness alone multiplied by the 0.8 power of the number of thicknesses. Against destruction by repeated battering blows, the built up plate is the better, if the fastenings are properly made (6). 8-inch plates will give better results if spaced to about 5 inches and the intervals filled with wood; but against mere penetration, the effect of the wood will not exceed at the most 2 or 3 per cent. and may be neglected.

EFFECT OF PROJECTILES ON ARMOR MADE OF

Resistance of armor to projectiles of	Wrought-iron.	Steel. Wrought.	Steel. Cast-steel facing on wrought-iron backing. Browne-Ellis plate. Cammell-Wilson plate.	Steel. Oil-chilled steel-face on forged-steel backing. Schneider plate.	Chilled-cast-iron with chilled face on soft back. Grusop plate.
Chilled-cast iron.	Shot broken; but with small loss of energy. Armor penetrated, but holds together.	Almost the same as wrought-iron.	Shot broken, and effect slight. Armor slightly penetrated and generally cracked or broken up.	Shot shivered; Surface of armor but slightly affected; armor may be cracked or broken up.	Shot shivered on first impact. Surface of armor very slightly affected; armor not penetrated, but may be cracked and finally broken up.
Steel cast.	Shot broken by oblique impact; unbroken, but deformed by direct impact. Armor penetrated, but holds together.	do.	Shot broken. Armor penetrated, and generally cracked or broken up.	Shot broken up. Armor slightly penetrated, but may be broken up.	Shot shivered on first impact. Armor not penetrated but generally cracked and at last broken up.
Steel forged or compressed.	Shot sometimes unbroken by oblique impact; unbroken, and but slightly deformed by direct impact. Armor penetrated, but holds together.	do.	Shot broken. Armor penetrated, and may be broken up.	Shot broken up. Armor slightly penetrated, but may be broken up	Shot shivered on first impact. Armor not penetrated but generally cracked and at last broken up.

Oblique Fire.—Wrought-iron armor will ordinarily defect projectiles which strike at angles of less than 50° to 60° inclination to its surface. Steel armor will deflect projectiles up to 65° inclination.

NOTE.—These angles may be diminished by 20° to 30° in the case of superior fire, or thin or inferior armor.

Penetration.—The object to be gained by penetration is the power of carrying a bursting charge into or through the outer armor.

Penetration.—Long and careful experiments have determined, with fair accuracy, the penetration of known projectiles in known wrought-iron; but the shape and quality of projectiles and the quality of wrought-iron differ so much in themselves that it is almost impossible to get any formula that will apply accurately to all cases. The most useful rule, one probably as close to general accuracy as varying projectiles and armor will allow (usually termed Orde-Browne's short rule), is that the penetration in wrought-iron is one diameter of the shot per each thousand feet of the shot's striking velocity (4).

Various so-called exact formulæ have been carefully worked up by Noble, Inglis, Naitland, Helie, Froloff, de Brettes, Krupp, Adts, and other European authorities (5); but the so-called short rule of Orde-Browne is approximately a mean of them all, giving penetrations sometimes 20 per cent. less than Helie, and 20 per cent. more than Adts.

Other approximate rules, always wanted, but not always to be found, are the following:

A rigid backing of wood, iron frames, or granite may add from 5 to 50 per cent. against penetration, according to the amount of rigidity in the backing, providing that the fastenings are made strong enough (7).

Steel-faced iron is made from 25 to 33 per cent. more resisting (and about 50 per cent. more expensive) than the same thickness of wrought-iron (8).

All steel with an oil-chilled face has shown itself slightly superior to steel-faced iron; but it is not yet known whether this superiority is proportionate to the extra cost (9).

Chilled-cast-iron may be broken up, but has never yet been penetrated by any projectile. Engineers have not yet determined practically how thick it must be to stand a given number

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[1] See page 633 to 780, Holley, Ordnance and Armor, 1865 (It is but just to remark here that this work is by no means yet out of date, but, on the contrary, is still universally regarded in Europe as one of the most valuable publications of its kind.)

[2] See Glanz, Geschichtliche Darstellung der Panzerungen und Eisen-Constructionen, Vienna 1873.

[3] Royal Engineers Prof. papers, Volumes 10 to 21, and R. E. Prof. papers (occasional series), Vols. 1 to 8. A careful digest of these articles, with constant back references to the original fuller articles, is to be found in pp. 254-277, Vol. 7, R. E. P. P. (occ. series) for 1882; reprinted without the references in U. S. Ord. Notes, No. 151. This digest is the most valuable of the kind yet published; and should, with its foot note references, be in the possession of every Engineer Officer.

[4] R. E. Prof. papers, page 268, Vol. 7, 1882.

[5] See Kunka, Die Panzerthuerme, 149-156 for detailed formulæ: U. S. Engrs. Prof. papers, No. 17, page 23; Glanz, page 102.

[6] See Kunka, Gadaud, and compare with Prof. papers, page 260, vol. 7, 1882.

[7] See page 256, vol 7, R. E. P. P., for 1882; and Shoeburyness experiments of August 1883.

[8] See page 11, U. S. Engineers, Prof. papers No. 25 for 1883; also, page 274, vol. 7, R. E. Prof. papers for 1882.

[9] See page 39, U. S. Engrs. papers, No. 25, for 1883.

of shots from a given gun. The rule followed by the manufacturer is as follows:

For inland defence, $d = 0.323\sqrt[4]{f.\ t.}$

For coast defence, $d = 0.294\sqrt[4]{f.\ t.}$

in which d = maximum thickness of armor in feet. $f.\ t.$ = foot tons of living forces in the striking projectile.

This thickness is calculated under the supposition that the elasticity of the metal will allow the living force of the striking projectile to be distributed over the whole mass of armor plate, and not merely upon a circumference equal to that of the projectile.

No condensed general summary can be strictly applied to individual cases. The following table is, however, useful in showing in a general way the mutual effect of projectiles and armor upon each other.

When fuller tables are not within reach, those of the article on "Gunnery" in the Encyclopedia Britannica, ninth edition, can always be depended upon to determine the time of flight, the remaining velocity, ordinary penetrations, and to solve almost all the ordinary problems of gunnery ballistics.

In order that the requirements of heavy armor may be better appreciated, the following cases are cited from records of actual experiments. They represent the extreme tests to which heavy armor has so far been subjected.

Wrought-iron.—In August 1883, a 9-inch Whitworth-steel shell went through an 18-inch wrought-iron plate, besides a cast-iron supporting plate, an oak backing, and steel skin, and many feet of wet sand (10). On September, 24th, 1883, at Pola, an 11-inch Krupp-steel shell went through 25.5 inches of iron in the form of a 15.7-inch Cammell-wrought-iron plate, a 9.8-inch teak backing, a 9.8-inch Cammell-wrought-iron plate and 19 feet of earth (11). These penetrations lead by analogy to a penetration of over 40 inches of wrought-iron by an 18-inch gun. On August, 22nd, 1883, at Shoeburyness, a 16-inch 1,700-pounder chilled-iron shot went through an 8-inch wrought-iron plate, a 5-inch wood backing, another 8-inch wrought-iron plate, and went 10 feet farther into a solid masonry backing.

Steel-faced wrought-iron.—On June, 6th, 1882, at Shoeburyness, a 4-inch 13-pounder new-model-Palliser shot went through a 4-inch Wilson-Cammell steel-faced plate (12); and later an 80-pounder shot perforated a 6-inch steel-faced plate.

In November 1882, at Spezzia, the second blow from a 17.7-inch 2,000-pounder chilled-iron projectile twice broke an 18.9-inch steel-faced plate, one plate being of Brown and the other of Cammell manufacture (13). On August 22nd, 1883, at Shoeburyness, a 16-inch 1,700-pounder chilled-iron shot badly cracked and bent, though it did not break or detach, a 12-inch Cammel steel-faced plate *backed by* more than 12 feet of *solid masonry* (14). In the spring of 1884, at Shoeburyness, a 16-inch 1,700-pounder Palliser shell penetrated 8 inches and broke to pieces an 18.9-inch Cammell steel-faced plate (15).

The strength of steel-faced iron is not estimated usually at more than 1.33 times that of wrought-iron (16).

[10] See Orde-Browne on "Armor under different kinds of fire," in Iron and Steel Institute papers for 1883-4.

[11] See Krupp, on Krupp's experiments, 1883.

[12] In the presence of the writer; see also Orde-Browne, as above quoted.

[13] See page 38, No. 25, U. S. Engrs. Prof. papers, 1883.

[14] See United Service, as quoted in page 11, Army and Navy Register, Washington, for June, 21st, 1884.

[15] See page 11, No. 25, U. S. Engrs. Prof. papers, for 1883; also, Col. Inglis, page 274, Vol. 7, R. E. Prof. papers, for 1883.

Wrought-steel.—In 1876, a 17.7-inch 2,000-pounder chilled-iron projectile completely demolished (though apparently not able to quite perforate) a 21.75-inch Schneider soft-forged steel plate backed with 30 inches of wood (16).

Chilled or Hardened Steel.—In November, 1882, at Spezzia, it required four shots from 17.7-inch 2,000-pdr. chilled-iron projectiles to knock down an 18.9-inch Schneider forged-steel plate with a 6-inch oil-chilled face (17).

Chilled-cast-iron.—On October 22nd, 1883, at Magdeburg, it required four shots from 12-inch 980-pdr. steel projectiles to break up a Gruson chilled-cast-iron plate of 43.7-inch maximum thickness, without backing, but supported at its ends. In this case there was no penetration at all, and all the steel projectiles were shivered to pieces on impact (18).

Fastenings.—The methods of fastening armor plates to each other and to their backing or supports, differ with the material of the plate.

Wrought-iron and steel plates are usually bolted to each other and to their backing. If placed in a vertical or nearly vertical position, they should be well supported at the top and bottom by a strong wrought-iron hoop or ring (as in the Admiralty Pier turret); and should be firmly supported in rear, either by vertical iron box-girder posts at intervals of 5 feet to 6 feet (as at Admiralty Pier), or by vertical Z-shaped iron frames at intervals of 1.5 feet to 2.5 feet (as on the Devastation and Colossus). Wrought-iron armor may be arranged, either in a single thickness (as on the Neptune), or in two thicknesses with a teak filling between (as on the Devastation or Thunderer). Steel-faced iron armor has so far always been arranged in a single thickness (as on the Agamemnon and Inflexible), but may of course be combined anywhere with inner thicknesses of wrought-iron. Both wrought-iron and steel-armor may, either be backed with two thicknesses of teak wood, the second thickness filling the 2.5 foot intervals between vertical frames (as in the Royal Sovereign and Prince Albert), or be backed with a single thickness of teak (as in the Agomemnon); or may not be backed with wood at all (as at Admiralty Pier). The armor is always provided with an inner-skin lining on the inside of the teak backing (as on all English ship turrets), and generally (as on the Neptune), though (as on Agamemnon and Admiralty Pier) not always with a similar lining on the inside of its vertical frames, to prevent the flying of bolt heads on its interior. As a further protection, a leathern mantelet (as at Antwerp Fort No. 3) or a rope mantelet (as proposed for the Agamemnon and Admiralty Pier) is sometimes used also in rear of the armor to keep splinters and rivets from flying upon the cannoniers. Wrought-iron plates are bolted with Palliser (19) bolts which may pass, either through only two consecutive thicknesses of metal and wood (19), or entirely through all the thicknesses of metal and wood (19) or may combine both methods (as in the Devastation). Steel-faced plates and all steel plates are fastened to their backing, either by Cammell-Wilson wrought-steel bolts and cast-steel washers (as described in detail under "Agamemnon" in Report on Turrets), or by Brown-Ellis wrought-steel bolts and washers (as described in detail under "Colossus" and "Conqueror" in Report on Turrets); these bolts in both cases entering only a limited distance into the softer metal of the rear face of the plate, and in both cases being screwed in the rear side of the assembled plates.

Chilled-cast-iron armor plates are usually keyed to each other by means of wrought-iron keys and zinc (or other soft-metal) tenons, which lie within corresponding mortises or hollows countersunk in the opposed surfaces of the joints. The assemblage is made by placing the two plates side by side, inserting the wrought-iron keys in their proper places at the same time; melted zinc (or other soft-metal) is then run in from above until all the dove-tailed countersunk hollows are completely filled. The resulting construction forms an apparently solid mass without any exposed rivets or bolts either inside or outside.

(TO BE CONTINUED.)

[16] See Inglis, page 272, Vol. 7, R. E. Prof. papers, for 1883.

[17] See page 39, No. 25, U. S. Engrs. Prof. papers, for 1883.

[18] See Armor plate trials at Magdeburg, October 22nd, 1883, published by U. S. Engr. Dept. 1884.

[19] For details of these bolts, see Inglis, page 264 and Plate 2, Vol. 7, R. E. P. P., 1882; or page 5 and Plate 2, U. S. Ord. Notes, No. 151; also page 43, Supp. to U. S. Engrs. Prof. papers, No. 21.

Surveys of the Coast of Holland.

BY A. VAN HORN,

Translated for ENGINEERING NEWS.

The coast of Holland from the "Hoek van Holland," to the most northern point, called Helder, forms in its general outlines a flat concave curve, with a radius of 67.75 miles, a chord of 51 miles, and a rise of 5 miles. The ocean currents, running parallel with the coast and the violent western gales blowing direct against the coast, cause a continuous wash of the chain of dunes, the constant inland movement of the foot of the dunes, and the decrease and lowering of the seashore. These damages are sometimes so heavy, that as far distant as Pettem, Province of North Holland, the chain of dunes is entirely washed off, making the erection of artificial protective works necessary. Where the deep water lines approach to a threatening extent, the latter is protected by spurs. A considerable length of the strand must be protected in this manner.

The observations made during the last year in reference to the currents in the North Sea, reaching over a length of 9.3 miles, have shown that the curves of depth get nearer and nearer to the coast, and that the currents—the strong flood-currents especially—run stronger into flat concaves, because the course of the chord of this concave is N. N. E., and the course of the flood north-east. As long as the action of the North Sea remains the same, it is not probable that the encroachments inland will cease or decrease.

Better and more complete protective works have been used for many years, to counteract the great dangers, which threaten the rich marshlands lying behind the chain of dunes.

It is of great importance to know exactly the nature and the extent of the changes of the shore, so as to be able to construct the necessary works in time to prevent damages by the currents etc. The annual surveys of the shore, of the low water line, and of the foot of the dunes show which parts of the shore are being washed out, and therefore require protection.

The methods used in Holland are of interest and may be adopted on other coasts with the same success.

The entire coast line from Hoek van Holland to the Helder has been surveyed by triangulation; every 1,000 metres (3,280 feet), a point called a shore post has been permanently set. All surveys are based on them. They stand along the foot of the dunes above mean high water line; commence with 0 at the Helder, and end with number 117 at the Hoek van Holland. The systematic surveys of the shore were commenced in North Holland in 1843, and in South Holland in 1857, and have been repeated annually, since then, so that the changes of the coast of North Holland are known for a period of 42 years, and of the coast of South Holland for 28 years. The shore surveys are made as follows:

1. The surveys are usually made in September.

2. Those days are selected, on which the lowest water occurs in the morning and evening, giving an opportunity to take advantage of two ebb tides in one day.

3. Stormy weather, strong breezes, westerly winds and strong breakers after rough weather, prevent the survey.

4. East and south-east wind, blowing from the land and causing the least surf, are the best for the surveys.

5. On the days, when surveys are made, the flood and ebb tides are observed at the Helder and at Pettem, so as to be able to refer to them the elevations of the foot of the dunes and the distances of the shore posts with reference to the high and low water lines.

6. The base for these surveys is the high water line. The difference between high and low water is assumed as follows: At the Helder, 1.20 metres (3.93 feet), at Pettem, about 12.5 miles south, 1.60 metres (5.24 feet), and at Zandvoort, 41.5 miles south, 1.70 metres (5.57 feet). The last height of the flood is the same along the rest of the coast from Zandvoort to the Hoek von Holland, 117 kilometres (72.5 miles) south of the Helder. The intermediate points are reduced proportionally to this scale.

7. The elevations of the foot of the dunes are measured in decimetres and the width of the strand in metres.

8. The time of the surveys is arranged by high water at the Helder occurs at 6 .30 o'clock, at Pettem at 6 A. M. and at Zandvoort at 5.30 o'clock and that the highest water occurs 50 minutes later every day.

8. In making the survey from one shore the fact, that during full and new moon the post, the limit to which the last flood tide has run up, is ascertained; that line can easily be established by the marks and lines which the receding water always makes on the shore. As the movement of the waves during quiet weather is from 2 to 3 metres (6 to 10 feet), the last high water mark is located 2 or 3 metres seaward from the marks left by it. This is then accepted as the true line of the last high tide.

10. This mark is then used for the further operations; the distance to the foot of the dunes and the distance to the then existing water line are measured from this point, at a right angle to the shore posts, and the same distances are also measured directly from the shore posts.

The differences of length and elevation between the water line during the survey and the point of the last high tide furnish the necessary data for the determination of the distance of the low water line. This is based upon the nearly always correct assumption, that the grade of the shore is uniform. The proceeding is best explained by an example. Suppose:

The survey begins at the shore post No. 0 at the Helder, 3 hours after high tide. Let the difference between the mark of the proceeding high tide and the water line at the time of survey be 0.6 metres (1.97 feet) and the distance between the two 50 metres (164 feet). The difference of tides at this place is 1.20 metres (3.93 feet) hence the low water line is 100 metres (328 feet) seaward from the mark. In this manner the measurement can be made from each post at any time after the high water, if the hour is observed, when the measurement was made. The elevations and distances so obtained are corrected according to the high and low tide of that day and then reduced to the mean high and low water.

The results of all the 117 measurements are then arranged in a systematic manner, the distances of the shore posts are platted as abscisses and the distances of the high and low water lines and of the foot of the dunes as ordinates. In order to ascertain the relation of the foot of the dunes to the elevation, the height of the same is platted as ordinate and the distance of the shore poles as abscisses.

A review of the measurements show at once how irregular the changes of the shore are; in one year the shore has largely increased in width, and in the following year the reverse or so takes place. These irregularities can be easily explained by considering the great influence of the frequency and strength of storms and the course of the wind upon the formation of the shore, and by also considering the great difference it makes, whether the surveys are made shortly after a heavy storm or a longer time afterwards, during which time the dunes and the shore have increased again by sand drifts.

This proves, that no reliable conclusions can be arrived at by citing the annual observations of the increase and decrease of the shore. While, trying to ascertain the changes of the shore, the observations must be free of local and exceptional influences; this can be done only by representing graphically the results of several years. A period of five years is used in Holland; this period seems to be sufficiently long to neutralize the irregularities and furnish reliable information about the condition of the shore.

2. During the period of 1843-47 to 1857-61 the low water line changed little from post 0 to 35, but moved considerably seaward from post 35 to 71. During the succeeding period the movement amounted to much less and many sections even turned into reverse conditions, because the water along the coast of Holland has become a great deal deeper during last years, so that the movement towards the landside from 1857-61 to 1878-82 was: from 1 metre at post No. 99 to 114 metres (374 feet) at No. 104 The movement towards the sea between posts 53 and 58 is contributed to the influence of the piers of the harbor of Ymuiden.

Plan of the Shore of Holland from the Rotterdam Canal to the Helder.

3. The shore has widened from 1843-47 to 1857-61 along the coast of North Holland between posts No. 0 and No. 71, but narrowed since then, so that from 1857-61 to 1878-82—with the exception of Ymuiden—the width has decreased along the entire coast from the Helder to the Hoek van Holland.

Since 1857 the elevations of the foot of the dunes were also measured. It is natural that these measurements are less accurate than the other data. Regarding the increase or decrease of the shore, it is, however, of little account whether the foot of the dunes is located a few inches more or less towards the sea, while the elevation would be seriously affected by such an error. The surveys have shown that the elevation of the foot of the dunes from post

Between the Shore-posts.	Foot of Dunes.				Low Water Line.				Shore.				Dist. in feet.
	1843-47 to 1857-61	1857-61 to 1867-71	1867-71 to 1878-82	1857-61 to 1878-82	1843-47 to 1857-61	1857-61 to 1867-71	1867-71 to 1878-82	1857-61 to 1878-82	1843-47 to 1857-61	1857-61 to 1867-71	1867-71 to 1878-82	1857-61 to 1878-82	
Number.	Feet.				Feet.				Feet.				
0 to 3	+ 26	+ 21	− 30	− 7	+ 128	− 23	− 125	− 148	+ 102	− 46	− 95	− 141	9,843
3 to 20	− 39	− 43	− 33	− 75	− 3	− 23	− 112	− 134	+ 39	+ 20	− 79	− 59	55,775
27 to 36	− 32	− 35	− 20	− 55	− 30	− 10	− 112	− 121	+ 3	+ 26	− 92	− 66	29,528
36 to 53	0	− 13	+ 20	+ 7	+ 56	− 16	− 75	− 92	+ 56	− 3	− 98	− 98	55,775
53 to 57	+ 43	+ 3	+ 56	+ 59	+ 102	− 33	+ 236	+ 233	+ 59	− 36	+ 210	+ 174	13,124
57 to 71	+ 16	+ 7	+ 20	+ 26	+ 148	+ 10	− 125	− 105	+ 131	+ 3	− 144	− 141	45,930
71 to 100		0	+ 16	+ 16		+ 16	− 78	− 62		+ 16	− 95	− 79	95,146
100 to 107		+ 59	− 7	− 66		− 85	− 75	− 161		− 26	− 69	− 95	22,966
107 to 117		− 23	− 3	− 26		− 39	− 26	− 65		− 16	− 23	− 39	32,809

The table gives the changes of the foot of the dunes, of the low water line, and of the shore, commencing with shore post No. 0 at the Helder, and ending at No. 117 at the Hoek van Holland. The sign + means the seaward movement of the foot of the dunes and of the low water line, and the increase of the shore; the sign − means the inland movement and decrease of the shore.

This table shows:

1. The foot of the dunes from post 0 to 20 has been narrowed from 1843-1847 to 1882. South of the protective works at Pettem posts 27 to 101 ha e remained nearly unchanged; they have moved rather a little more seaward than landward. South of post 101 a strong decrease, mostly at post 104, can be observed, amounting to 76 metres (250 feet) in twenty-one years.

No. 0 to No. 22 has increased considerably during the period from 1857-61 to 1867-71, but that it since has decreased much more, so that, taking the entire period from 1857-61 to 1878-82, the foot between the posts 0 to 71 has been lowered considerably. South of post 71 to the Hoek van Holland, only small changes have occurred.

It would be hasty to predict, from the surveys made so far, the future changes of the shore. The period of observation is too short. No theory can be established as yet, according to which the changes take place. The method described does not give absolutely accurate results, as the assumptions are but approximately correct. This is, however, of little importance as such measurements do not need to be absolutely accurate for the purpose, to ascertain the changes of the shore. But the

method can be recommended on account of its simplicity, not needing extensive preparations.—*Wochenschr. des Oesterr. Ing. & Arch. Ver. Sept.* 26, 1885.

Sections 12, 13 and 14 of the New Croton Aqueduct.

The accompanying plans and elevations, Plates 1 and 2, show sections 12, 13 and 14 of the New Croton Aqueduct, the last portion of the aqueduct proper still to be let, and for which proposals are called on January 20th next.

Section 12 includes shafts No. 24, 25 and 26, and the tunnel or inverted syphon under the Harlem River. At about station 1,480 on the east bank of the river the aqueduct takes a downward dip of 15 feet in 100 feet, until it reaches a point somewhat east of shaft No. 24, where it decreases from 12 feet 3 inches in diameter to 10 feet 6 inches, and, with a grade of 2 feet in 100 feet, passes under the Harlem River to the foot of Shaft No. 25, at which point the bottom of the sump is 166 feet below Croton datum.

The test borings made in the bed of the Harlem show hard rock for the greater portion of the tunnel line, but towards the west bank a deep pocket filled with gravel and sand is indicated, and the rock is marked "doubtful;" this formation *may* necessitate a change in the grade of the western half of the river tunnel as shown by the dotted lines on Plate 1, though a test drift from the bottom of Shaft No. 25 can alone decide this point.

The river tunnel will be lined in parts requiring it by a shell of cast-iron plates with outside flanges, one inch thick; but the engineers believe that for much the greater portion of the length, the ordinary lining of 16 to 20 inches of brickwork backed with concrete, and the solid rock will be sufficient for all demands upon it.

Through shaft No. 25 the water rises to the level of the New York city end of the aqueduct, and this shaft being under pressure is sealed by inverted arches just above the aqueduct roof, as shown. The elevation at which the aqueduct leaves the shaft is 13.5 above Croton datum. This shaft No. 25 is double, each division being 12 feet 3 inches in diameter; one is the aqueduct shaft proper, and the other is a pumping shaft to be used in clearing the river tunnel of water for cleaning or any necessary repairs. The aqueduct shaft needs little description; the pumping shaft decends to a lower level than the other, and the two are connected at the bottom by a gate sufficiently large to admit a man, and manipulated by a valve rod passing up the 36-inch pipe shown on the plan. It is proposed to do the pumping by two large buckets provided with a bottom valve and running in guides built in the pumping shaft, and the gate below makes it possible to cut off the pump-shaft and empty it in case any repairs are needed to the guides or any accident happens to the buckets. The bottom valve likewise can be made to act as a blow-off of any silt, etc., deposited in the bottom of the aqueduct shaft, by first emptying the deeper shaft alongside, and then opening this gate and allowing the water to escape under the pressure due to its hydraulic head.

As shown on Plate 2, a blow-off made of two 4 feet cast-iron pipes imbeded in concrete in a rock tunnel, is provided about on a line with the bottom of the aqueduct proper. These blow-off pipes will be utilized in emptying the portions of the tunnel on both sides of the river that have a hydraulic gradient higher than high water in the Harlem River. The pipes terminate in a gate-house on the river-bank, provided with the proper valves, etc., and a 36 inch main, which communicates with the high service pumping station near the High Bridge. This latter arrangement makes it possible to take water for the high service from the new aqueduct in case there is any trouble or necessary shut-off of the old Croton supply, crossing the High Bridge. Both the aqueduct and the pumping shaft will be lined with 1½ inches of cast-iron, and the specifications provide that this lining may be made in solid rings about 5 feet high and be connected by a "bell-and-spigot" joint as in water pipe, instead of the horizontal and vertical bolted joints shown in Plate 2.

Shaft 26 (Plate 2) is intended as an overflow or regulator of pressure at the gate-house at 135st street. The nearest other vent of this character is at South Yonkers, and as there may be fluctuations in the flow this provision will compensate for them. The arrangement is simple and plainly illustrated; two 4 feet cast-iron pipes will carry off the surplus water from the overflow.

Section 13 starts a little west of shaft No. 26 and passes to Station 1557, near 162nd Street, with a total length of about 4,700 feet; it contains two ordinary shafts, Nos. 27 and 28, one 143, and the other 123 feet deep. Section 14 commences at Station 1557 and runs to a gate-house near 135th Street, and Convent Avenue, a distance of 7,160 feet. Shafts 29, 30, 31 and 32, being under pressure, will be sealed by inverted arches. The tunnel on both sections will be 12 feet 3 inches in inside diameter, and in its construction similar to the portions on the east side of the Harlem already described in this journal.

At the gate-house at 135th Street, the aqueduct proper will terminate, and from there the water will be conveyed to the Central Park reservoir by 48-inch cast-iron mains. There will be ten of these mains leaving 135th Street, but two of them will be turned directly on to the distribution, leaving eight of them to pass to the Central Park.

Paving Sets.

Sets when properly secured in position and formed of the hardest stones are so durable, even under the heaviest traffic, that it is not worth while to make them more than from 6 to 7½ inches deep. Two depths are employed in Liverpool: the first for moderate traffic, averaging 6½ inches; and the second for the heaviest traffic, averaging 7½ inches. In relation to its other dimensions, a set should be of such depth that when the wheel of a heavy cart passes over one edge of its upper surface it should not tend to tip. The resultant direction of pressure of the load and adjoining sets should, in short, always tend to depress the whole set vertically. Where as frequently happens, this precaution is neglected, the maintenance of a uniform surface is impossible. This consideration would lead *per se*, for sets of the above-mentioned depth, to a surface of 4 or 5 inches square. Sets of this figure remain comparatively stable even on bad foundations and with defective joints. There are other influences, however, which lead to a modification of this form. It is desirable that the width of each set measured along the street should be small. If it is large, a horse drawing a heavy load attempting to find a joint slips back, and requires an exceptionally wide joint to pull him up. The wide joint induces increased wear of the upper corners of the sets, and increased noise. In practice the author has found that, for all but the softer stones, upon which, even if there were no joints, horses could travel with facility, it is desirable that the widths of the sets should be such that four taken at random, and placed

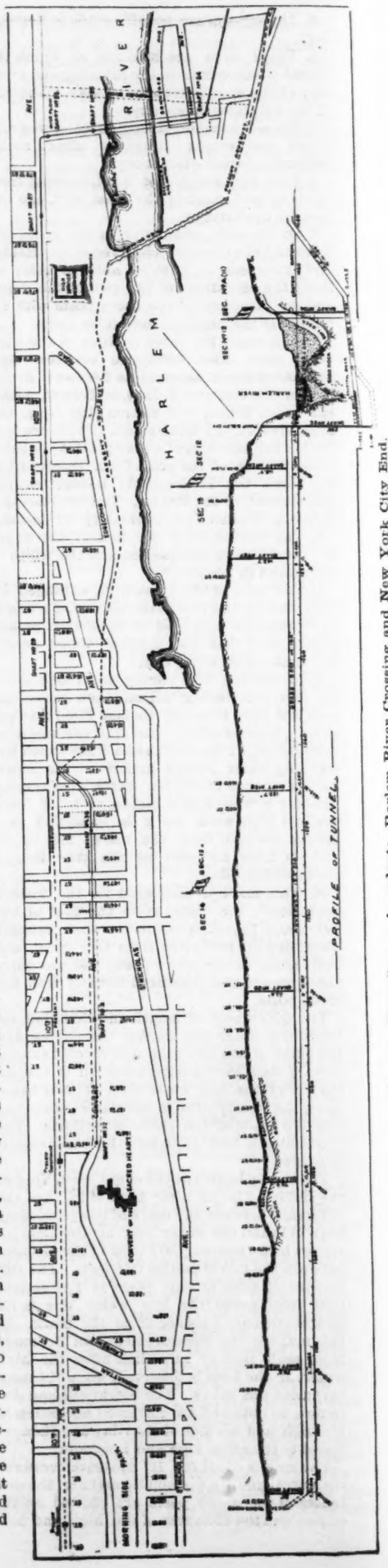

Plate I.—New Croton Aqueduct:—Harlem River Crossing and New York City End.

side by side, will not measure more than 14 inches across. As in this measurement the irregular projections of the sets are taken into account, the average surface width is less than 3 inches; and if with this width the surfaces are square, the number of longitudinal joints is so great that it is impossible for the paviors to break joint properly, and at the same time to keep the joints close, without much loss of time in selecting each set as it is placed. Two or more longitudinal joints in nearly

gains in strength, inasmuch as the outer surface is to a considerable extent changed, and made like malleable cast-iron, gaining in toughness. There is a gain in weight of about one-half of one per cent., owing to the oxidation, and a scarcely perceptible increase of volume. The protection is very perfect, as has been proved by burying test pieces for one year in the ground in very damp and unfavorable places. The coating is liable to have its appearance injured by handling, and for ob-

Moreover, the soaking in water makes the wood less liable to twist and warp in subsequent drying, and when it is cut up into scantlings for use, besides rendering it more proof against the attacks of worms, though its strength is supposed to be slightly diminished thereby, which seems to be borne out by the fact that the loss of weight is greater in water seasoned wood than when it has been merely air seasoned. If placed in water it is better that it should be completely submerged, as noth-

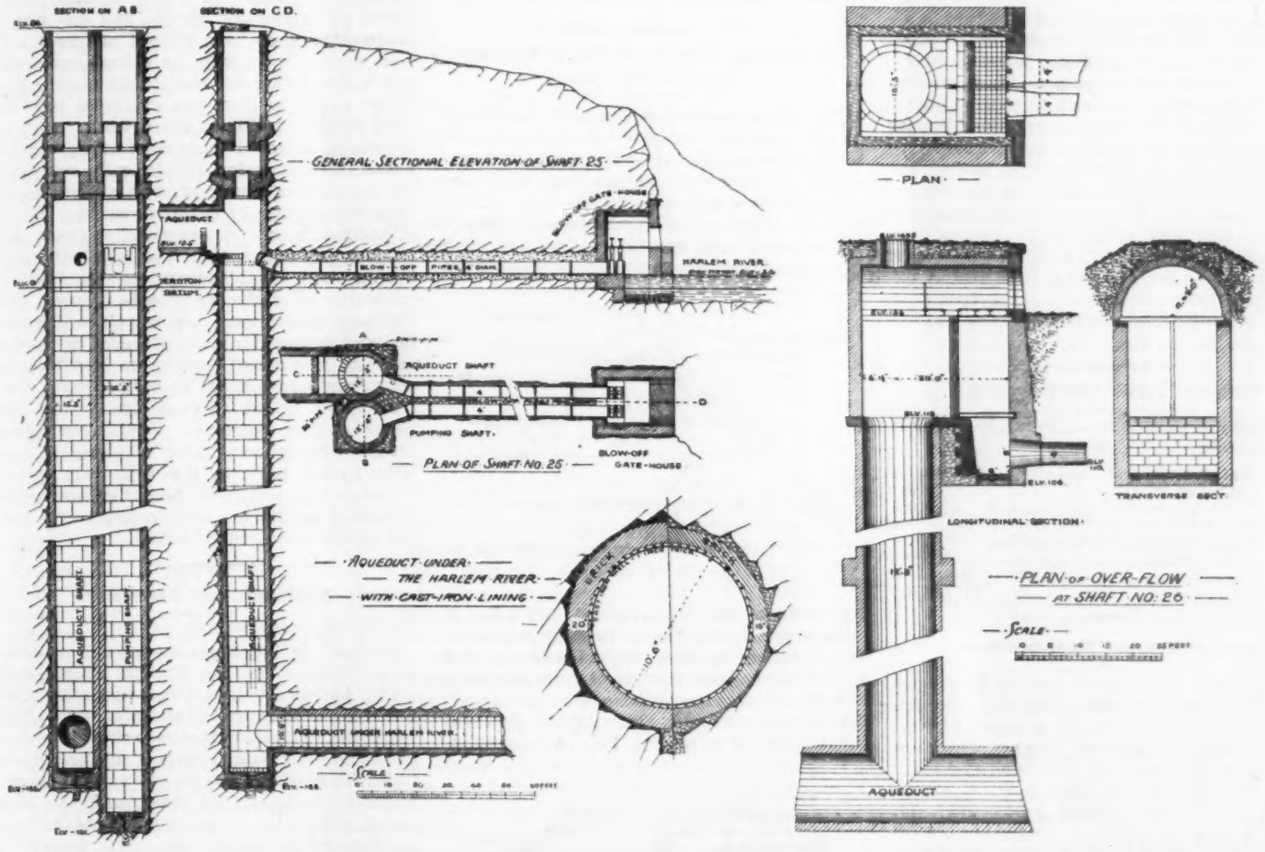

Plate 2.—New Croton Aqueduct:—Aqueduct and Pumping Shaft and Overflow at Shaft No. 26.

the same line, or a single rather wide longitudinal joint, almost invariably initiates a groove.—*G. F. Deacon.*

The Bower-Barff Process for Protecting Iron.

The Bower-Barff process for protecting iron from rust, by covering it with a skin of magnetic oxide of iron, appears to be steadily gaining in favor in Germany. It is not infrequently mentioned in German technical journals, and always with approval. Recently at a meeting of a branch of the German Engineers' Society, at Hanover, a paper was read by one of the members, in which he very strongly recommended the process to engineers and architects. Speaking of the fine blue-gray color of the coating formed, he said that this was always the more beautiful the cleaner the surface of the articles operated upon. The coating adheres very strongly to the metal, but still not so strongly as to allow of working iron so coated beyond a very limited extent. Thus wire cannot be bent without cracking off the oxide formed on it. Therefore all articles to be protected should be finished before the oxidation takes place. As regards the strength of iron treated by the process, the results of experiments go to prove that wrought iron does not in any way suffer by the oxidation, and that cast-iron

jects where this is a matter of importance, it is better to brush the surface over with grease or wax, which is absorbed into the oxide and remains in it, permanently protecting it. Another property of objects coated with the oxide, is specially pointed out as of great value for some purposes, especially for objects of art. The oxide coat easily takes enamelling, silvering, gilding or platinising. The enamel, or the solution, can be put direct upon the oxide, and then after firing adheres perfectly and has not the tendency to crack off, as in the case of its application to the bare iron. Then a coating of bronze or other metal can be given to objects in the simplest manner by brushing them over with a brush made of the metal in question. So much of the metal penetrates the oxide coating that the result is perfectly permanent.

Seasoning of Timber.

Though air-drying is the best and most certain way of promoting durability in wood without impairing its strength, the time it takes is often a great drawback, hence the immersion of the newly-felled timber in water is resorted to in order to arrest any tendency to change, by washing out of the pores of the wood all sap and other substances which tend to promote fermentation, and hence decay.

ing is so injurious to timber as being exposed to alternate wet and dry. The generally received opinion is, that for ordinary purposes a fortnight's immersion in running water is sufficient, though much must depend on the size of the balks so treated. M. de Lapparent, one of the Government inspectors of timber in France, recommends for timber used in shipbuilding one year's immersion in river water, two years in fresh, or three in brackish water, constantly being changed, to be followed by two years of air-seasoning. The gradual processes of air and water seasoning are the only ones which can be safely applied to timber in large scantlings; still, artificial drying may often be successfully employed in the case of smaller scantlings, more especially in the preparation of timber for joinery, for which purpose it should be quite dry and free from any tendency to shrink.

Amongst such systems we may mention drying in ovens or hot chambers, exposed to currents of air ranging from 90 degrees for hard woods and large sections, to 200 degrees for soft woods in thin boards, the process being carried on until the wood has lost from one-fifth to one-third of its original weight, according to the purpose for which it is required to be used. Boiling and steaming wood for three or four hours are often resorted to, as the subsequent drying is there by rendered very rapid,

and the tendency to shrink and twist is reduced to a minimum, whilst the wood becomes so pliable that ribs and planks can be bent to any required curve, and, if confined until dry, will readily retain the form so given them. Smoke-drying may also be employed at times with advantage; but carbonising or charring the outer surfaces of the wood, though very effectual in preserving it from the destructive influence of alternate wet and dry, such as the ends of posts let into the ground are so much exposed to, must never be regarded as a substitute for seasoning; for though keeping out external moisture, it effectually imprisons that which is in the pores of the wood, and so hastens internal decay. While on this subject it may be as well to observe that paint, tar, and all similar waterproof coatings are only preservatives so long as the timber is already seasoned and free from moisture, as then they keep it dry; but if not, they become the most certain agents of destruction. For imperfectly seasoned timber the best preservative against the weather is a rough-sawn face, which forms a shield against both sun and rain, and at the same time offers no check to the evaporation of the moisture from the pores of the wood.—*H. C. Seddon, R. E.*

Proposed Public Works of Paris.

THE City of Paris intends to make the following loans:

For Waterworks and Conduits	$19,000,000
" Drainage Works	8,000,000
" Purification of sewage matter	4,200,000
" Street Department	60,000,000
" Beautifying and Illuminating the streets	800,000
	$92,000,000

German Cement Manufacturers.

The Assoc. of German makers of cement adopted at their last annual meeting the following resolutions, for the purpose of freeing the market of spurious cements, which are sold under the name of "Portland Cement." The resolutions read as follows:

The undersigned cement works are compelled by the facts that for many years several cement works have mixed foreign substances with the Portland cement after it was burned, and that they still label the same as pure Portland Cement, to make the following declaration.

1. Portland cement is a product obtained by intimately mixing lime and clay, these being the principal ingredients, and then burning the same until they become hard and as fine as flour.

2. Any product, which is made in a different manner, or which was mixed during or after burning with other substances, is not Portland cement. The sale of such under the name of "Portland Cement" is a fraud on the purchaser.

3. Assumed improvement of the compressive and tensile strength of cement by addition of other substances does not play a decisive part in this question, as (*a*) the increase in strength has only been proven by tests in laboratories, by using substances, the nature of which has not been revealed,—it is therefore uncertain whether the same admixtures used in practice were used in the laboratories; (*b*) because the foreign substances mixed with the cement are proportionally much larger in the cement sold (in some cases even 50 per cent,) than in the cement used for testing; (*c*) because the substances used by the works, as slags, clayish slate, kaolin earth, hydraulic lime, etc., do actually not improve cement, but make it less valuable.

4. This habit of mixing will undermine the confidence in pure Portland cement, as people themselves are not able to ascertain the real quality of the mixture and the nature of its ingredients.

5. The undersigned cement works bind themselves to sell only such cements as Portland cement, which answer the conditions expressed under No. 1 of this declaration.

The association therefore demands that all cements mixed with other substances shall be sold under a different name than "Portland Cement."—*Deutsche Bauzeitung*, 1885, pp. 167, etc.

Transporting Logs to the Sawmill Borregaard in Norway.

The large saw-mill Borregaard is situated on the shore of the river Glommen, in immediate neighborhood of the celebrated waterfall (61 feet high) of Sarpfoss, and cuts annually from 200,000 to 240,000 logs. Until recently it was a very expensive and difficult operation to take the logs out of the river Glommen above the cataract. A proposition

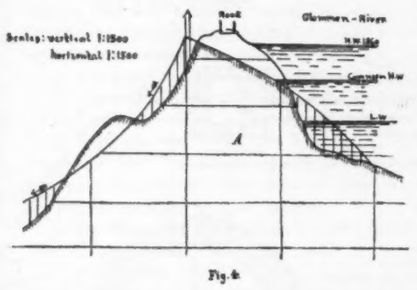

Fig. 4.

was made to cut the river dam (*A*. in Fig. 4) with a canal or a flume, to float down the logs. But, as the dam was made of clay, and as it might happen, that the river would make a new cut, this proposition was not entertained. Instead of it, the patented arrangement, presented in Fig. 1-3, was executed.

Fig. 1.

Fig. 2.

Fig. 3.

The logs are pulled up by an endless chain, which is moved by rope-transmission and a turbine of 120 horse power. The chain is supported at every 5 feet by little trucks, running on two wheels, on which the logs are laid, the smallest end upward. The velocity of the chain is 5.13 feet per second. From this chain road the logs are dumped into a steep dry run, lined with sheet-iron, and about 350 feet long. A steeper run adjoins this one, in which the logs are moved by water, using 55 cubic feet per second. 200 logs are moved in an hour on an average.—*Teknisk Tidskrift*, 1884.

The Inaccuracies of Chilled Car Wheels.

At a recent meeting of master car-builders at Boston, Mass., it was stated that the 24-inch chilled iron carwheels were liable to be ¼ inch different in ranges of diameter and an equal amount in eccentricity, both variations being caused by irregularities in cooling. The sentiment of the meeting was reported to be against grinding the wheels to accuracy in concentricity and diameter, as involving a useless expense. These opinions do not seem to be warranted by an examination of the facts. The evils of uneven wear of chilled wheels are well known, and universally ascribed to skidding the wheels by excessive application of the brakes, but as such use of brakes is forbidden, and at present somewhat infrequent, is it not more probable that it is in great measure due to the enforced slip caused by fastening wheels of different diameter upon the same axle? Taking the extreme case of a 24-inch wheel and a 24¼ inch wheel upon the same axle; in a 100-mile run there would be a difference of 871 revolutions or 5,529 feet in the distance compassed by each of the wheels, and one wheel or the other must have slipped on the track more than a mile, with its consequent wear which would soon find the softest parts in the wheel, not to mention the excess of tractive force required to do this extra work. Such of the wheels as were ¼ inch eccentric would be raised 1751 feet during the 100-mile run; and the one-third of a mile of vertical component must pound rolling stock and roadway. Some of the best managed American railways use on their passenger cars, wheels which have been ground, but this comprises only a small proportion of all the car wheels in use. The Pullman parlor cars use wheels which are made of an annular mass of paper, 36 inches in diameter, pressed between an iron boss at centre and surrounded by a steel tyre; thin iron plates bolted to each side protect the paper against exposure. There are other forms of car wheels made of pieces of iron with rubber between the iron body of the wheel and the steel tyre; and they have given excellent results, but the excessive first cost has retarded their introduction.

Engineers and Architects.

Translated for ENGINEERING NEWS.

M. Emile Trélat, who occupies a very prominent position in the French engineering world, had an article in a recent number of *La Nouvelle Revue* under the above caption. The writer draws a parallel between the two professions and finds many points of divergence between them, which may be new to our readers. According to him, "the ideas, methods, education, temper and preoccupations of the two are entirely different. One calls himself a scientific man, the other an artist. Apparently they have one dictionary, but, as a matter of fact, they have two languages." The words are the same but the meanings are different; they exchange speeches but not ideas, and thus their communications are few and there is no *entente* between them. In writing more especially of the civil engineer, attention is called to his "young face," to his modern appearance on the stage of industrial life. The name of his profession is an adopted one that is met with pretty often in going back through past ages which have conferred on him a long genealogy. The great discoveries of the 17th century opened up vast fields for the civil engineer, while the *savants* of the 18th and 19th centuries were his foster fathers and teachers.

In the 17th century the laws of weight and gravity were established and generalized in that of universal attraction, and the calculating processes that allow causes and effects to be married together were discussed. A new scientific horizon was opened up by the knowledge of the movements of bodies and their causes. Galileo, Hooker, Newton and Leibnitz founded Mechanics.

But after having defined the relations of the movements of bodies and the intensity of the forces which maintain them and measured the effects of these forces and determined the conditions of their equilibrium, the *savants* went further. They recognized that the action of

forces was transmitted through bodies, since they found these bodies, either in a latent state in the movements produced, or in a sensible and measurable state in the resistances to movement. They observed too, that on a body mechanically immobilized the effect of the work of a force is not integrally collected beyond the body—that it is not entirely transmitted to the resisting support—that a portion of the force is spent in producing *individual* movement in the interior of the body. Displacements of particles to particles are effected, local resistances, of more or less efficacy, are created at each point and propagated sometimes in very complex ways. A whole series of hidden but real phenomena is perceived. Science demonstrates and unveils these phenomena. Between the bodies of pure theoretic conception which would transmit integrally the work of a force, and the real bodies which fail and break under the effort, scientists have interposed and define the resisting body, that we utilize daily in our works. It is the object which mechanically immobilized suffers in its individual constitution and undergoes changes in its figure that are sometimes insensible but are always real. The obelisk of Luscor is one of the simplest examples of this permanent phenomenon. Its foundations produce reactions that are opposed to the action of weight exercised at all points. This science of the resistance of materials is enriched with great names: Mariotte, Bernouille, D'Alembert, Coulomb, Dupin, Tredgold, Hodgkinson, Navier, Poncelet, Bélanger. It may be said that we have at present a positive science with relation to the placing in equilibrium of a number of bodies and their resistance.

The engineer is the special depository of this science: "the *savant* of the stability of the resistance and duration of materials in constructed works." His special sciences are: Mechanics and applied Chemistry and Physics.

M. Trélat denies the engineers any plastic taste—form is not in his line, and here begin those points of divergence between the architect and engineer. The civil engineer seeks only to distribute and build the edifice. There is actually a mild kind of antipathy between the two professionals. The engineer would prove by $a + b$ that the public edifices, put up by the architect, could be constructed with far less material. It would seem that these differences are from various causes, more marked in France than here. The French architect regards the civil engineer as treading on his preserves. The engineer in France has in fact made a specialty of laying out mills and appurtenances, and created a new order of edifices: "having a maximum of vacuum with a minimum of cost." The estrangement between the two is somewhat similar to that which existed between physicians and surgeons in the last century. The education of the architect and the engineer is different. The Institute indeeed has no special schools for the latter, but the State has and gives employment to the graduates making public functionaries of them. But the profession is free and despite the multifarious branches which now are included in it there is far more unity than might be supposed and unequal disciplinary strength. The entire movement of the profession is satisfactory and progressive. The architect has not the same position, privileged members of the Ecole des Beaux Arts have little in common with the heterogeneous mass of the body. The education of the engineer is deficient so far as architecture is concerned, while the architect on the other hand has a false estimate of the *role* of the engineer. M. Trélat believes that a great reform can be made here, but he admits the difficulty of harmonizing the two professions. In treating of the subject he makes the following remarks which certainly have some application here: "One of the "sore spots" of the times is just here, the professions contain a large number of individuals who have mistaken their vocation. The activity of our modern world increases the number of these dangerous mistakes. Our free Society with its fruitful but boundless competition increases individual responsibility and makes each of us precocious assailants of the economic equilibrium. The vocation of architect and engineer are peculiarly subject to this evil."

How to Improve Roads.

Henry county, O., has been well nigh ruined by mud. With lethargy born of a sense of despairing helplessness the people have submitted to their heavy burdens. Year after year the mud blockade has almost stopped the wheels of business for periods of weeks at a time; amounting in all to nearly one-fourth of the year. Everybody prays for good roads, but nobody puts his shoulder to the wheel. Our roads can be very materially improved at an expense entirely within the means of even this tax-burdened people. By all means let us have stone roads as soon as possible; but first let us prepare a place to put the stone, to insure us against the chance of losing it in mud unfathomable. For the sake of illustrating, let us suppose that we are going to make an entirely new road. After the road is located we will stake out the track, which should not be more than 20 feet wide. After this is done, let a competent and trustworthy civil engineer stake out two lines for tile drain, each a few feet from the center line of the road bed. Then tile should be laid to a perfect grade, not less than an average depth of three feet and carried to the nearest outlet, no matter what the distance nor what the expense. This is an absolute necessity, as without efficient tile drainage there can be no good road-built in Henry county, either of stone, gravel or any other material that is accessible. After the tile are laid as above directed, proceed to raise the road-bed about 15 inches in the center and 8 or 9 at the outside, by scraping upon it the surface soil. No clay should be allowed on the road. It should then be made perfectly even and smooth. No hillock or hollows should be allowed under any circumstances. It will then be a good plan to go over it several times with the heaviest rollers and make it as compact as possible. Then dig your side ditches with the same care as to grade and outlet as was done with the tile. These open ditches need not be deep, but should be so graded that no water will stand in them to soak and soften the bed of the road. They will carry off the water that falls upon the road while the tile will carry that which comes up from below.

In order to keep this road in good condition, appoint a man to go over it every day in the wet season and draw off the water from puddles that may form on the bed of the road and fill them up, and also to keep the side ditches in good working order. The road should be completed as early as the middle of August, so that it may be well settled before the fall rains set in. Let the above principles apply to old roads. The road-bed need not be raised more than two feet above the general level unless in crossing a low place.

After you have constructed your road in the above manner, you have a foundation upon which you may build your stone or gravel road, which you may delay doing until you feel able to bear the expense. When you wish to put stone on the road, make it twelve inches thick at the center and six or eight at the side; the width should be from 12 to 15 feet. This done you have a road that will be a pleasure to travel on at any time of the year. Farmers can then sell their produce when the price is most satisfactory.

There are three prime essentials to road building in this locality. They are, first, drainage; second, better drainage, and third, the best drainage possible.—*T. C. H., in Napoleon, Ohio, Signal.*

Telegraphic Communication with West Africa.

An important aid to the commercial development of the West Coast of Africa will be the telegraph cable which will before the end of next year extend along its shores, touching at the principal ports and reaching to the mouth of the Congo and to St. Paul de Loanda. There at present exists telegraphic communication between Europe and Dakar, Senegal, *via* Cadiz, on the one hand, and between Europe and the Cape Verd Islands on the other, and in three or four months it is expected that Sierra Leone will find itself in duplicate telegraphic communication with Europe. The Spanish Government are in treaty to have Fernando Po in connection with this system, and the German Government are also thinking of opening stations in the Cameroons district. The importance of this West African telegraph line to the development of commerce in these regions, observes the *Times*, is self-evident, and has been recognized by the several Governments that have subsidised these new lines. When the cables are open for service there will be fewer of those surprise annexions of which we have had so many recently. In 18 months time there will be a further extension of telegraphic communication along the coast. The Government of Cape Colony has been authorised to subsidise a West African telegraph line, the laying of which will place that Colony in duplicate communication with Europe, so that the Colony will be independent of complications in Egypt. The completion of this line to the Cape, gives a circle of communication round Africa, and consequently gives every point touched an alternative route.—*The Colonies and India.*

Monsieur Paul Trasenter, a Belgian engineer and a son-in-law of the well known writer Emile de Laveleye, has just published a work of travel on the United States, entitled: "*Aux Etats Unis.*" The great engineering works of this country are noted at length, among them the Brooklyn Bridge, the Hudson Tunnel. Mr. Trasenter also visited Canada and the Far West. Writing of the South Chicago Works he states that it could alone supply the entire French demand for rails. The zinc Works of Mathiesen & Hegeler at La Salle and the Lake Superior mining region are also described.

TUNNELING BY FREEZING.—A novel application of cold air machinery has just been made in the construction of a tunnel at Stockholm. The tunnel passes through a hill consisting in great measure of a light wet gravel, on which a number of very large houses are built. It was practically impossible to underpin the foundations of these houses on account of the expense, and the contractor, Captain Lindmark, therefore decided to attempt to freeze the gravel by means of cold air, the lining being put in when the material was solid. This has now been successfully accomplished by one of Lightfoot's patent dry cold air machines made by Messrs. Siebe, Gorman & Co., London. The results have been in every way most satisfactory, and already several large houses have been safely passed under.—*Engineering.*

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WE have just seen a somewhat curious reprint of a pamphlet letter, written last year by W. W. Evans, the well known American engineer, to the Chief of the U. S. Bureau of Statistics. This "Fagot of Yankee Sticks" dealt with American products and their present importance and future possibilities when brought into competition with the manufactures of other lands, and it is illustrated throughout by telling bits from the extensive foreign experience of the writer.

This reprint comes from Calcutta, though no imprint is given, and is utterly unauthorized by the writer who has on his title page especially reserved the "privilege of manuscript." While the text proper is very far from being complimentary to English products and English methods, the party reprinting it has made Mr. Evans loudly sing the praises of certain English manufacturers by the judicious use of *foot notes*, which do not appear in the original pamphlet, but which are artfully worded so as to seemingly come from Mr. Evans. The re-publication seems to be almost entirely in the interest of a few British firms who are thus advertised in an otherwise scathing Yankee pamphlet.

THE Canadian Pacific Railway Co., according to *The Colonies and India*, has shown at Antwerp "melons, tomatoes and other fruits grown in the open air," with potatoes, Indian corn, squashes, pumpkins, parsnips, onions, peas, cabbages, etc., all without forcing collected from Moosejaw, Dunmore and Medicine Hat, 300 to 600 miles west of Winnipeg, which are now shown at the Smithfield cattle show.

THE Muscatine water-works
same hands; the city did not
as reported in this paper some
The appraisment was to go
regular form, but the price
much for the city and they co
go, for the present at least.
The appraisers for the
Thomas N. Hooper, Esq., of
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The expensive journey from this coast either by railroad or steamer, deters any large immigration, and so far but three steamers have sailed from Europe to our Pacific coast and though they had freights out at 28 to 30 shillings per ton and received 80 shillings for return freights, did not find the voyage of 15,800 miles profitable. But with a Ship Railway on the Isthmus of Tehuantepec the distance which now, by the way of Cape Horn, is between New York and San Francisco 15,687 miles, would be reduced to 4,690; from New Orleans the distance would be reduced from 16,112 to 3,561 and from Liverpool the reduction would be from 15,803 to 8,276 miles. Or at fifteen miles per hour the time would be from New York thirteen days and fourteen hours, from New Orleans ten days and from Liverpool twenty-three days and sixteen hours, At the rate of $35 from Liverpool to New York the fare would be from New York to San Francisco $57. Thus neither the time nor expense would be at all prohibitory, and we could expect to see the Chinese driven out by the substitution of better material for citizenship, people who would marry and settle in the country, increasing its wealth and productiveness by the demands this improved condition would create.

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ENGINEERING NEWS

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AMERICAN CONTRACT JOURNAL.

TRIBUNE BUILDING, - - NEW YORK CITY.

THE ENGINEERING NEWS PUBLISHING CO. PROPRIETOR.

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WE have just seen a somewhat curious reprint of a pamphlet letter, written last year by W. W. Evans, the well known American engineer, to the Chief of the U. S. Bureau of Statistics. This "Fagot of Yankee Sticks" dealt with American products and their present importance and future possibilities when brought into competition with the manufactures of other lands, and it is illustrated throughout by telling bits from the extensive foreign experience of the writer.

This reprint comes from Calcutta, though no imprint is given, and is utterly unauthorized by the writer who has on his title page especially reserved the "privilege of manuscript." While the text proper is very far from being complimentary to English products and English methods, the party reprinting it has made Mr. Evans loudly sing the praises of certain English manufacturers by the judicious use of *foot notes*, which do not appear in the original pamphlet, but which are artfully worded so as to seemingly come from Mr. Evans. The re-publication seems to be almost entirely in the interest of a few British firms who are thus advertised in an otherwise scathing Yankee pamphlet.

THE Canadian Pacific Railway Co., according to *The Colonies and India*, has shown at Antwerp "melons, tomatoes and other fruits grown in the open air," with potatoes, Indian corn, squashes, pumpkins, parsnips, onions, peas, cabbages, etc., all without forcing collected from Moosejaw, Dunmore and Medicine Hat, 300 to 600 miles west of Winnipeg, which are now shown at the Smithfield cattle show.

THE Muscatine water-works are still in the same hands; the city did not purchase them, as reported in this paper some time ago.

The appraisment was to go through in the regular form, but the price was, it seems, to much for the city and they concluded to let it go, for the present at least.

The appraisers for the company were Thomas N. Hooper, Esq., of the Davenport water-works and Col. J. N. Dewey, Esq., of Des Moines, and on the part of the city J. Lin. Hoops and Hon. B. H. Garrett. The fifth man appointed by the district, was Judge and Col. Milo Smith, Esq., of Clinton, Iowa.

THE railroad fever has broken out bad in Kansas. New lines are projected to run across the State in every direction, and to encircle the State with an iron band. The present railway mileage of the state is 4,500 miles; in 1885 there were 70 schemes incorporated calling for 12,675 miles of road, and they are still coming in. Kansas railway incorporators do not limit their ambition to their own borders, but boldly grasp the continent. One scheme proposes to build 2,400 miles, on a capital of $48,000,000; the latest starts off with $100,000,000 to build a line from Florida to Oregon. Civil engineers and contractors will need to "handle with care" any propositions looking towards their employment in this ambitious state when the construction season fairly opens.

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At present there is not skilled labor enough on our western coast. As producers the Chinese do well, but as consumers they are a failure, living as they do very cheaply and greatly on goods brought from China, to which country all their earnings are sent or carried. Their labor and presence is of but little more value to other producers in California and Oregon than if employed at home.

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On account of the scarcity of fuel, Italy has few advantages in manufacturing and working iron, so that, as lately as 1880, we read in "*The Journal of the Iron and Steel Institute*: "Italy's function of late years has been rather that of assisting to develope the metallurgy of other countries than to promote the advancement of her own." But the government has, as much as possible, placed its orders in the private establishments of the country, and under this fostering care Italy competes as a bridge builder with America, England and Belgium.

Attention is called to this fact, as a bill has lately been introduced in the Senate providing for *two* Government gun factories. If our guns are made in private works, a large part of the plant and skilled labor employed would be available for commercial uses, and all of it for orders from foreign governments.

Germany by giving her orders to Krupp has built up an establishment that employs about 25,000 men, and the sale to other nations of Krupp's guns and the accompanying ordnance stores must bring an appreciable revenue to Germany.

All have lately seen the probable value to the prosperity of a country of a large manufacturing establishment, for it is Krupp's capital and credit that is one of the principal factors in the efforts to secure for German engineers and German manufacturers and merchants the profits that would accrue from controlling the railroads of China.

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It does not seem the most economical plan to employ two plants, and train up two sets of experts, not necessarily, and we might say probably, intercommunicating their knowledge solely, to fabricate two articles so much alike in their requirements as guns for use on shipboard and in forts. Nor are the places selected for the factories well chosen. Washington has no advantages for iron working nor iron works near it; the parts of the guns must be freighted for some distance, and the broad estuary on which it is situated invites attack. West Troy is near one establishment that might easily be fitted to make and forge the steel required, and is not liable to hostile demonstrations, but the industries on the Hudson river are on a very stable foundation, and it would be better, if our Government is to force the industries of any section of the country, to force those of that section that, on account of scarcity of capital requires it the most.

The Chief Engineership of the Philadelphia Water Department.

The controversy over the Chief Engineership of the Philadelphia Water Department is becoming interesting and decidedly personal, judging from the press of that city.

Col. Ludlow, the present incumbent, has made a very good official record, and his army training and experience and individual independence of political leaders, has doubtless stood him in good need in introducing better discipline and system into the workings of his department. But in addition to more thorough business methods, the department has been made more efficient in all matters pertaining to hydraulic and mechanical engineering; and just to whom the credit belongs for this latter important improvement is a question that the present chief engineer and his late Superintendent, Mr. de Kinder, are trying to decide by published statements in the daily press.

Taking these statements as they read, the Superintendent seems to have the best of the argument; and it looks as if he had been the engineer in about all that belongs to that title, and that the official head had confined himself to the no less important duty of general manager of the department. This is only a natural deduction to make from the past professional record of these two gentlemen. Col. Ludlow, as a military engineer holds high rank, and doubtless has had all the experience that usually falls to the lot of officers of his corps in the United States. But we are not aware that steam-engineering holds anything like a prominent place in the usual routine of service of an army engineer; nor do we see where they have ever had the opportunity to gain any practical knowledge of the building and handling of great pumps, and the demands of an intricate system of city water distribution. We make this query with all due courtesy to Col. Ludlow, and with the full acknowledgment of the much good service he has really done for the Philadelphia Water Department, notably in the very efficient manner in which he has gone about securing correct and elaborate data for the future extension of its water supply.

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Taking these records as they stand, the wisdom of Col. Ludlow in appointing so able and experienced an executive engineering officer can not be too highly applauded; but we decidedly disapprove of the present vigorous effort to belittle the professional services, and smirch the personal record of this officer, now resigned, solely because he looms up as a possible rival, for the office in the coming election. From the standpoint of professional fitness, Mr. de Kinder is quite as eligible as Col. Ludlow, with much more experience in some of the most important duties of the office; and the charges made of over-running appropriations and authority are well met by Mr. de Kinder's published statement of controlling circumstances which throw a very different light upon the case.

Aside from any personal considerations there is a question of principle and precedent involved in this especial controversy that seems to have been overlooked. Civilian engineers engaged on government work are now making a fight for equality of rank and pay with army engineers, when both are engaged on exactly similar professional service. And their case and their claim will be made much stronger if the policy is to be encouraged of permitting the army officer to temporarily lay aside a lucrative government position to encroach upon the domains of the civilian engineer, and take a position at an increased compensation that properly belongs to, and can just as well be filled by the civilian. The one has an assured position for life, with a regular advance due to years of service alone. The other must be content with what his experience and merit can secure for him, and at times struggle along without position or pay, and without the backing of the government. Good positions for civilian engineers are altogether too scarce, as it is, to allow any division with a class which can exist very well without them.

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spects to the Council of Political Reform, and tears to pieces the comparative statement made by it regarding the relative city expenditures of New York and Brooklyn in the working of his department. Mr. Smith shows that the actual per capita cost of the department for 1884 was $1.85, instead of $3.47, as stated by the Council. A few of the *corrected* figures for New York are given as follows:—Maintenance of water pipes, $231 per mile; boulevards and drives, $267 per acre; water meters, cost of inspection, $1.36 per meter, not $4.59 as per Council, and for 1885, the cost was only 97 cents per meter; the laying of water pipe in New York, with fourteen miles laid at a cost of $175,091, includes labor, material, specials and inspection, and the work is very generally in rock excavation; while in Brooklyn, the item used in comparison, is for labor only, and no rock excavation is allowed, and even boulders are rarely found.

The maintenance of 360 miles of paved streets in New York cost $190,562, or $577 per mile, instead of $1,409, as given by the Council. The streets of New York are also from five to seven feet wider on the average than the average of Brooklyn streets. As for the comparison, it is shown that, in 1884, Brooklyn paid 46 cents per square yard for pavement repair, and New York 65 cents, but the Senate Investigating Committee of 1884, from the evidence before it, showed that it cost twice as much to repair a granite, or trap block, or Belgian pavement, as it did to repair and maintain a cobble pavement; and 90 per cent. of Brooklyn pavements are cobble, while only 10 per cent. of New York paved streets are of this nature.

In repaving, after sewer and water connections, 3,876 openings had to be provided for in New York in 1884. The total cost for this work was $23,095, or $5.94 per opening, or 64 cents per square yard; this sum includes the maintenance of the pavement over the opening for one year.

The Manchester Ship Canal.

Herapath's *Journal* says that several gangs of men are now engaged in digging trial shafts in Cheshire along the line proposed to be taken by the Manchester Ship Canal between Eastham and Runcorn. Engineers are also engaged staking out the course through Cheshire.

The company now propose petitioning Parliament to be allowed to pay interest on their stock during construction.

A Good Professional Opening in England.

The *Contract Journal* says, the commissioners of sewers for Arundel invite applicants for the position of surveyor to send in written applications accompanied by testimonials. "Age not to exceed forty-five. Salary £85 a year, paid quarterly, with the necessary traveling expenses and postages. Security of £300 will be required."

We do not know whether "traveling expenses and postages" is as elastic a term as the California lawyers' "drinks and mule hire," but there ought to be some additions to a salary of $425 per year.

Grease in the Boston Sewers.

During a recent visit to Boston our attention was called to an accumulation of sewer grease in the east shaft of the Dorchester Bay tunnel on the improved sewerage system.

This grease is a black, dirty but quite solid compound which comes floating down the sewers to the pumping station. In the eddies in the filth hoist and pump-well it accumulates into balls of varying diameter, passes through the pumps and settling tanks and from there into the tunnel. When these floating balls reach the bottom of the east shaft they there naturally ascend towards the top of the shaft, which is constantly filled with sewage, instead of passing up the incline leading to Squantum.

This accumulation in the top of the shaft is now sufficient in volume and solidity to readily support the weight of a man, being 5 or 6 feet thick. Whenever one of these grease-balls is cut open, a bottle-cork is invariably found in its center, showing that the floating grease gathers around the cork as a nucleus in the eddies mentioned, or in its passage through the city sewers, for the balls are found in numerous other locations than in the tunnel mentioned.

The grease itself is utterly worthless, being filled with dirt and foreign matter.

New York Academy of Sciences.

The first public lecture of the season was given in Hamilton Hall, Columbia College, on the evening of January 4, by Mr. P. H. Dudley, the well known inventor of the Dynagraph. The subject of the lecture was "Fungi Inducing Decay in Timber," and it was very fully illustrated by stereopticon pictures, especially of specimens of "Scaly Lentinus," *Lentinus lepideus*, Fr.—species of fungus so destructive to railway sleepers and timber of yellow pine the (*Pinus australis*) in this vicinity.

As may well be taken for granted for anything prepared by Mr. Dudley, the lecture was exceedingly practical and correspondingly valuable, especially to every railroad and bridge builder, who may wish to learn all he can about the timber he is using. The lecture will be published in full in this journal as soon as the Academy has issued it in its regular Transactions, which will be within two months ensuing.

The First Railroad in China.

The following communication to the New York *Tribune*, of December 28th, is interesting to promoters of railroad building in China:—

SIR:—In the interesting editorial on "Railroads in China," in your issue of to-day, I see a statement that "the first railroad experiment in China was a disastrous failure." Now I have not the pleasure of knowing the Baron de Lorme, to whom you allude, and of his plans. I know only what I have read in the papers. But I do know all about that first railroad, inasmuch as I was an original director, and one of the committee of two who went to London to negotiate for its construction. It extended (about ten miles) from Shanghai to Woo-Sung, at the mouth of the Wong-Soo River, and was intended by its projectors to be the first section of a line to Soochow, the "Paris of China." I think all who were concerned in it take pride in what they accomplished. It was built and operated, but unfortunately, as the majority of owners were British, the corporation became of that nationality, and while British ownership in the far East involves an excellent chance of protection, it also involves responsibility.

You say "the people would not tolerate it!" but for "the people" you should say, "some of the Mandarins," which, permit me to state, is quite another thing. The British had a very troublesome diplomatic settlement with China on the carpet at that time; and in said settlement the wily authorities (not the people, mind you) managed to include an agreement that this little British railroad should be sold to them for removal to the island of Formosa. Of course we were sorry for this, and thought the English action unprecedentedly weak and stupid; but as we received the face value of our capital in cash, with 10 per cent. premium, one can hardly call the enterprise "a disastrous failure." There are those, I think, who could habitually court disaster of this kind.

Had our railroad been managed first and last as was that remarkably successful Danish organization, the Great Northern Telegraph Company, it would not have been sold, much less torn up; and it would, in all probability, have done its work as a pioneer line. These Danish promoters set an example worthy of being followed by others in China. The first telegraph line (English, too) was torn down by the people; and wires must needs give more offence to "Fung-shuey," or the Spirit of the Air, than humble rails. The great native officials, too, almost choked with range when application was made to land the cable from Hong Kong at Shanghai. Yet our shrewd and clever friends from Copenhagen found means to conquer both Fung-Shuey and Mandarins, and achieved unparalleled commercial results. Similar success with railroads would bring fame and fortune to those interested, and why it should not be attained by similar methods, I fail to see.

Truly yours,
A. A. HAYES.

Washington, D. C., Dec. 24, 1885.

A New Transit for Engineers and Surveyors.

T. M. Jackson has invented a new attachment for a transit, consisting of the ordinary vertical arc and vernier, spirit-level and tangent screw, but so arranged that they can readily be detached from the transit, when not needed, and packed into a morocco box that can be carried in the pocket if desired.

The advantages claimed for this device are, that it removes a certain amount of dead weight from the transit; that it removes a frequent source of trouble and damage in carrying the instrument through heavy undergrowth, and finally that in running a plain transit line, the extra friction and slight eccentricity of the bearing, due this unbalanced weight, is avoided and the telescope can be much more easily reversed and sighted when the spirit-level, which would then be on top, is removed entirely.

These attachments can readily be placed on any transit; the cost complete, with vernier reading to one minute, and case, being $65,00. W. Gardam & Sons, 96 John St., New York, are the sole manufacturers.

PERSONAL.

HUGH B. FITZPATRICK, a railroad contractor, was suffocated by gas, Dec. 22, in his room at Lancaster, Pa.

Chief Engineer of Public Works, ROBERT VAN BUREN, of Brooklyn, is too ill to attend to the business of his department.

DANIEL GILMARTIN, a well known contractor, of Brooklyn, died, Dec. 21, at his home, 216 Twenty-first street. He was fifty-eight years of age.

STEPHEN BARKER GUION, the well known owner of ocean steamships, died suddenly from apoplexy at Liverpool, Dec. 19. He was born in New York in 1820.

H. A. SCHWANECKE, of Pittsburg, is Chief Engineer of the Eastern and Western Air Line Railroad; W. C. MOBLEY is General Superintendent.

W. S. BURDETT has been appointed Chief Engineer of the new Florida railroad—Fort Mason, Seneca and St. John's River; headquarters, Jacksonville, Florida.

MR. A. W. GODSON, contractor, of Toronto, Canada, has issued a writ against the *Globe*, claiming $20,000 damages for libel in connection with the construction of the Garrison Creek sewer, which the *Globe* characterized as a scandalous job.

MR. HENRY WOODALL, gas engineer to the Leeds Corporation, has been appointed chief engineer to the Melbourne Gas Company. His salary in England has been £650 per annum; there it will be upwards of £1,500 a year.

MR. CHARLES NEILSON is appointed general superintendent of the Cincinnati, Hamilton and Dayton Railroad, and took charge January 1st. The road has had no general superintendent for several years. MR. NEILSON was for eleven years on the Erie road, and a little

over a year ago resigned the position of superintendent of the Buffalo and Rochester divisions of that road to become assistant to the president of the Laflin & Rand Powder Company. MR. NEILSON'S office will be in Cincinnati.

FRANK H. CLEMENT, late Division Engineer of Division III., South Penna. R. R., has taken a sub-contract on the New Croton aqueduct under Clark & C'Brien, and is reported to be putting his tunnel experience to excellent use.

At the meeting of the Indiana Tile and Drainage Association, held December 8th and 9th, last, at Indianapolis, the following officers were elected for the ensuing year: *President*, Thomas Chandler, Indianapolis, Ind.; *Vice-President*, G. S. Pollock, Sullivan, Ind.; *Secretary*, T. A. Randall, Indianapolis, Ind.; *Treasurer*, M. J. Lee, Crawfordsville, Ind.

RUDOLPH WIESER, Civil Engineer and Contractor and formerly chief inspector on the St. Louis Bridge, sailed on the 13 inst. for Brazil, Buenos Ayres and the Argentine Republic. MR. WEISER, who was at one time connected with Capt. Eads on the Hydraulic Commission for the improvement of harbors and rivers in Brazil, goes to South America on a purely personal tour of inspection.

The death of MR. FREDERICK SWANWICK is announced. He was born in 1809, and was for many years confidential assistant and private secretary to the great railway pioneer, George Stephenson. On the opening of the Manchester and Liverpool Railway in September, 1830, there were eight locomotives engaged, and the "Arrow" was driven on that occasion by MR. SWANWICK.

CAPT. F. V. GREENE, U. S. Engineers, has just taken the one year's furlough due him, and has accepted the position of Vice President of the Barber Asphalte Co., for the purpose of fully testing all the capabilities of this class of pavements. CAPT. GREENE has had peculiar facilities for closely studying the characteristics, defects and merits of asphalte pavements, and being an acknowledged expert upon this important branch of city improvement, we can expect some very good work as the result of his personal and close study and examination of existing works.

A bronze bust of the engineer SOMMEILLER was unveiled on July 14th, 1885, on the north side of the Mount Cenis Tunnel. SOMMEILLER was born in 1815 in Annecy; he received his education at the Academy of Sciences in Turin During the period from 1857 to 1871 he was most prominently connnected with the planning and construction of the Mount Cenis Tunnel, an enterprise of then unparalleled magnitude. He improved the rock-drills and air-compressors. His machines were tried at an expense of $40,000, and the favorable results obtained encouraged the Italian Government to commence the gigantic work of tunnelling the Mount Cenis. SOMMEILLER'S name is most intimately connected with the advancement of tunnelling.

JOHN G. STEVENS, a nephew of the late Edwin A. Stevens, of Hoboken, and the President of the United New Jersey R. R. and Canal Co., committed suicide in the Penna. R. R. office at Trenton on Jan. 6, by shooting himself in the head with a revolver. MR. STEVENS was about sixty-five years old and in his day an acknowledged authority on railroad and canal engineering, and a power in the State of New Jersey during the supremacy of the Camden and Amboy R. R. Co. As engineer he located most of the roads of that company and was President of the Delaware and Raritan Canal Co. He was recognized as the best and almost the only authority in the State on the value of railroad and canal property. He had been prominent lately in connection with the Panama and Nicaragua canal companies, he having examined both schemes and pronounced in favor of the latter.

FRANK EVANS, C. E., has been elected City Engineer of Los Angeles, Cal. It is reported that this city proposes to expend nearly $500,000 in the present year on improvements.

JAMES MOYLAN, late Principal Assistant Engineer on the construction of the New York Elevated railways, has returned to New York from Albuquerque, N. M., where he has been engaged as Engineer of Maintenance of Way, on the Atlantic and Pacific R. R.

CHAS. E. GOAD, C. E., Member of the American Society of Civil Engineers, and well known to many of the Society, has in connection with his Montreal and Toronto offices opened another at 4 Finsbury Circus, London, England. He is now engaged personally in London in making surveys in the city.

FRANK BREWER, A. M. I.. C. E., late Principal Assistant and Acting Chief Engineer on the Ohio Valley Railway, formerly U. S. Dep. Min. Surveyor and County Surveyor, of Dakota, is now in practice at 17 Broadway, N. Y., ready to undertake Railway or other Engineering work, Surveying or Draughting; his card appears in this issue. Specialty, fine Draughting.

A. D. CONOVER, Prof. of Civil Engineering, University of Wisconsin, and late City Engineer of Madison, Wis., was in New York this week and attended the meeting of the A. Soc. C. E., on Wednesday evening. MR. CONOVER is Superintending Engineer and Architect of the new University buildings at Madison, and his trip to New York was on business connected with this building, especially relating to the purchase of the iron therefor.

J. J. DE KINDER, ex-superintendent of works of the Philadelpha Water Department, has made a reply to Chief Engineer Ludlow's statement referring to and condemning partially MR. DE KINDER'S course as an official. MR. DE KINDER challenges any member of Councils to say that he ever asked for vote or favor, or ever pushed himself as a candidate for chief of the department, unless in case Colonel Ludlow was out of the field. Letters from MR. DE KINDER to Colonel Ludlow, written last July, are given, showing that at that time the writer denied the accusation of electioneering. The whole of the discussion about the operations of the Kensington pumping station is then gone over again; and MR. DE KINDER'S side of the case given with greater detail than before. As to the bills on which payment was withheld, MR. DE KINDER asserts that their correctness can be readily settled in a court of justice.

Austria has lost her most prominent shipbuilder and civil engineer, EDUARD STRUDTHOFF. After completing his technical education in England he became in 1857, when the Stabilimento Tecnico was founded at Trieste, the head of the ship-yards of that establishment at St. Rocco, which, under his supervision and by his technical ability, in the course of time advanced to the front rank among its kind. All the large ironclads of the Austrian navy—the Hapsburg, Custozza, Albrecht, Don Juan, Max and Tegethoff—were constructed and built under his direction, as were also a great number of war vessels for Turkey, Greece, Italy, Russia and the South American States. His premature departure, being only a little over fifty years of age, is a lamentable loss to his country.

American Society of Civil Engineers.

The meeting at the House of the Society on Wednesday, January 6, was largely attended, Vice President Greene in the chair.

After some routine business the paper on "Specifications for Strength of Iron Bridges," presented by Joseph M. Wilson, C. E., to the Annual Convention at Deer Park, was brought up for discussion. This paper brought out a variety of opinions upon this important subject from the members of the society, all of which were in writing and read by the Secretary. The members taking part were: W. H. Burr; Mansfield Merriman; S. W. Robinson; Geo. F. Swain; G. Bouscaren; Mace Moulton; A. P. Boller; Geo. H. Pegram; Wm. Sellers; Jas. G. Dagron; Geo. L. Vose; J. B. Davis; E. Thacher and C. C. Schneider.

The ballot for membership submitted resulted as follows:

FOR MEMBERS: *Maximilian Ferdinand Bonzano*, formerly Assistant Engineer Philadelphia, Wilmington and Baltimore Railroad; now Division Engineer Philadelphia and Reading Railroad, Philadelphia, Pa.; *Franklin Ide Fuller*, formerly Assistant Engineer Water Department, Providence, R. I., afterwards Res. Eng. Milwaukee and Lake Winnebago Railroad; Assistant Engineer, New York, West Shore and Buffalo R. R., and of the Northern Pacific Terminal Co.; now with the Portland Construction Co., Portland, Oregon; *George Watson Kittredge*, formerly Assistant Engineer on the South Boston Flats Improvement; then with the Pittsburgh, Cincinnati, and St. Louis R. R. Co., and now Engineer Maintenance of Way, Muskingum Valley Division, P. C. and St. L. R. R., Zanesville, Ohio; *Henry Wadsworth Reed*, formerly Assistant Engineer Savannah, Florida and Western R. R., now Master of Roadway of the same Railroad, Waycross, Ga.; *Henry Frederic Rudloff*, Government Engineer of Venezuela, and Chief Engineer Caracas and Antimano R. R., Caracas, Venezuela, South America; *Albert John Scherzer*, formerly Principal Assistant Engineer Connecticut Western R. R.; recently Chief Engineer and Superintendent Guatemala Central R. R.; now Chief Engineer and Contractor, Ferro Carril de Santa Anna, Sonsonate, Salvador, Central America.

FOR ASSOCIATE: *Calvin Tomkins*, Tomkins Cove Lime Company, 387 South Street, New York City.

FOR JUNIOR: *Harry Lee Van Zile*, member of the firm Van Zile, MacCormick and Company, operating Troy and Albany Bridge and Iron Works, Troy, N. Y.

Indiana County Surveyors and Civil Engineers.

The Sixth Annual Meeting of the above association will be held at Indianapolis, in the office of the County Surveyor, on January 19th, 20th and 21st. Besides the regular business of the Convention, there will be an address by the President, and papers as follows: "Bridges," by T. A. Hardman; "Roads and Highways," by J. T. Campell; "Fees of County Surveyors," by H. B. Fatout, of Indianapolis; "Drainage of Swamps," by Lewis S. Alter; also several volunteer papers, of which titles have not been given. An exhibition of instruments will also be held. We quote from the circular letter:

"Our association has made steady advancement from the first, and we have strong assurance of a more rapid growth and advancement in the future. No active Surveyor or Civil Engineer of the State can afford to miss these meetings. All City Engineers should come and bring the questions and difficulties of your business. Water-works Engineers should come and exchange views and gather new ideas; so should Electric and Gas Engineers. Several Instrument

manufacturers are expected to be present, and all are cordially invited. Ample time and opportunity will be given to display their instruments and explain the same. Any one wishing to purchase new instruments can here get all the advantages of a visit to the largest and best houses in the United States.

Bring your tapes and chains along and compare with Standard measurements.

Commissioners of Drainage, Bridge-builders, Contractors and all others interested in the profession are cordially invited to attend. Any one having any questions to ask, plans to submit, or papers to read, will please report the same to the Corresponding Secretary by the 10th of January. There will be an unusual amount of important business before the Society.

Reduced Rates on Railroads and at Hotels are expected to be secured.

Come prepared to advance the cause and enjoy a good time. LEWIS S. ALTER, Cor. Secy."

American Society of Civil Engineers.

RECORDS OF MEETINGS.

For the contained abstracts of interesting papers read, we give the following official record of meetings as addenda to the reports already published:

DECEMBER 2d, 1885.—Mr. W. Howard White, M. Soc. C. E., read a discussion upon the subject of Wind Strains in Bridges. This will be given at a future time, with discussions upon the paper, by Mr. Joseph M. Wilson, on Specifications for Strength of Bridges.

Discussions upon a paper by Mr. G. H. Pegram, M. Am. Soc. C. E., upon Formulas for the Weight of Bridges, were presented from Messrs. A. J. Du Bois, Jun., Am. Soc. C. E.; Wm. H. Burr, Assoc. Am. Soc. C. E.; J. S. Elliott, C. E.; and Geo. H. Pegram, M. Am. Soc. C. E. These will be printed with the original paper in an early number of the Transactions.

Discussions by Messrs. A. G. Menocal and E. L. Corthell were then read, upon a paper previously read by Mr. Corthell on the subject of Canals and Railroads, Ship Canals and Ship Railways, which paper had been presented in the discussion on the paper by Mr. E. Sweet, M. Am Soc. C. E., on the Radical Enlargement of the Erie Canal. Mr. Corthell considers that the gradual abandonment of canals, and the rapid and general introduction of railways during the last forty years, are patent facts; but that the reasons for this change are not so well known. He refers to the great difference between transportation on the open sea and in the restricted channels of canals. He gives instances confirming the theory that the boat itself creates, by its movement through the water of a restricted channel, a serious resistance to its progress; and states that experiments on the Preston Canal, in England, show that the proper and economical speed upon canals was from two to two and a half miles an hour. Experiments in India show that, where the depth was slight, a launch could not make more than one to two miles per hour in a canal, but five miles per hour in a greater depth. Experiments in England show that the resistance of the wave, produced in advance of the boat or vessel, decreases as the depth increases. On the Aire and Calder navigation, in England, where steam barges are used, and the boats are about 63 feet long, 12 feet wide and 6 feet draft, the velocity is not over 4 to 5 miles an hour. On the Belgian canals, in restricted channels, steam-towing tugs are reduced to 2¾ miles, and to 4½ miles in wider rivers. On the Erie Canal, freight steamers make 40 miles in 24 hours. The conclusion of Professor Barlow is, that the power required to overcome the resistance to the passage of boats was at the cube of the velocity. Figures are given to show, that in operating canals in Belgium, they cannot compete with railroads when maintenance and interest on first cost are included. A number of quotations from eminent engineers, extending from 1830 to 1857, are given, tending to show that canals could not compete with railroads; and the writer thinks that it has not been possible to make any improvements since then, in speed or economy of canal transportation, but that railroads have greatly developed in both these respects. He gives the increase in train loads, and in the relation of live loads to dead loads on our railways, and also the great increase in the volume of freight carried over our trunk lines, comparing that with the decrease of the freight carried upon the New York State Canals. He states that there was no reduction in rates on the Erie Canal until it was compelled by a reduction on the railroads, and also that the United States Census Bureau states that about 2,000 miles of canals, nearly one-half of all that have been constructed, have been abandoned. The original cost of construction was about $50 000,000, and railroads now occupy the beds and banks of many of them. The average cost on the Pennsylvania Railroad, Main Division, and the Philadelphia and Erie Division, is about 4 mills per ton per mile, which includes local as well as other freight, and all expenses, except interest on capital. On the same railroad, Susquehanna Division, the actual cost of hauling was 0.6 of a mill per ton per mile. The cost of towing by steam canal-boat with consort is 1 mill, running cost alone; but for all expenses, except terminal, 3.15 mills per ton per mile. This for full loads both ways. Freight transported by canal is more cheaply handled than that transported by railroads. Speed of steam canal-boats, running-time on the Hudson River, is 5 miles per hour and 2.1 miles on the Erie Canal, while on the railroads between the West and New York the average running time is at least 15 miles per hour.

Resistance to be overcome in an ordinary canal exists, to a greater extent, in a ship canal. Instances are given showing this fact. The speed through the Suez Canal is reduced to 5 miles per hour. On the River Clyde, where the channel is about 150 feet wide and 10 feet deep, when vessels of 120 feet in length have been, at rare intervals, propelled at a speed of from 8 to 9 miles per hour, a wave of from 8 to 9 feet in height has been produced in advance of the vessel, with a destructive action upon the slopes of the hand-laid stone on the banks. Similar effects are produced by a steamer passing through the South Pass of the Mississippi River. The cost of the transportation of freight steamers in the ship canals would be about six times as much as on the ocean. The cost of hauling on a railroad on the same basis would be about one-fifth of the cost on the canal.

The writer next presents an estimate of the cost of operating a ship railway, such as is proposed for the Isthmus of Tehuantepec. He states that railroad transportation in this country shows that it is possible to haul freight at about 4 mills per ton per mile, including all expenses. A large proportion of this cost is in handling freight, the expenses of which have not been much reduced, while continual reductions are being made in the cost of hauling. He estimates the cost at the Isthmus of Tehuantepec for maintenance of way, for operating terminals, for operating ship turn-tables, for motive power, for telegraph, for incidental and general expenses, at $1,088,720 per annum, and adding ten per cent. for all other expenses and contingencies, $1,197,592, or 30 cents per ton on four million tons. The profit at $2.50 per ton would be $8 800,000. If six million tons were carried, the cost per ton would be 23.3 cents. The working expenses on four million tons would be 12 per cent. on the gross receipts at $2.50, or 10 per cent. at $3 per ton. He also compares the cost of carrying freight on the ordinary railroads with that on the ship railway, resulting in a verification of the figures given above. He states that the cost of the construction of the ship railway will be $75,000,000, probably $300,000,000 for the Panama Canal, and $200,000,000 for the Nicaragua Canal. Lieut.-Col. McFarland estimates for the latter $140,000,000, with labor at $1 per day. The cost of maintenance will be much less for the ship railway. The bed of the railway is not subject to dangerous floods or slides. Its width is about 50 feet as against 200 for the canal. He refers to the expense which will be required at Panama on account of the extent of the slopes and the dangerous volumes of the Chagres River floods. He states that the cost of towing vessels through these canals will be much greater than hauling on ship railways; also that the Tehuantepec route will save an average of 1,000 miles on the main commercial lines, as compared with either the Panama or Nicaragua. It is an advantage to the ship to be docked for 18 or 20 hours, as it may be scraped, cleaned and painted in port. The tolls on the ship railway can be increased over those of the canal route to the extent of the saving of the ship's expensive use of power during the time of transit. The time occupied can be made as short as at Panama, and one-fourth of that at Nicaragua. He concludes with the statement that a canal cannot compete in speed, or economy, or facilities with the railroad, and that a ship canal must be more expensive in cost of maintenance and operation, and that the Tehuantepec Ship Railway has advantages over any other interoceanic communication.

In discussion, Mr. A. G. Menocal, M. Am. Soc. C. E., states that the distinguished designer of the proposed ship railway estimates the expenses of operating that railway at 50 per cent. of the receipts, which is yet much below the cost of operating railroads in this country. Mr. Menocal gives the financial statement of the Suez Canal Company for the year 1883, showing that the maintenance and working expenses were 20 per cent. of the gross receipts, but that the year 1883 was exceptional as regards exceedingly large expenditures.

He considers that there are good grounds of belief that the cost of working and maintaining the Nicaragua Canal will be less than for the Suez Canal. He states that the average speed of vessels passing through the Suez Canal in 1883 was a little over five miles an hour, omitting delays at terminals and siding and during the nights, when navigation is suspended. He states that the location of the Nicaragua Canal has been materially modified by several surveys, so that it is now 170 miles long, with 48¾ miles of canal, eight of which traverse a deep basin where no excavation is needed, and 121½ miles are lake and river navigation. Of this, about 30 miles need dredging to a mean depth of cut of less than 4 feet. The balance is 48 miles in the lake and 43 in the river, where the depth varies from 30 to 130 feet, the river being nowhere less than 1,500 feet wide. He estimates that the time of transit by the ship railway will be 26½ hours, exclusive of detentions, and by the Nicaragua Canal 23¼ hours, and that the detentions at the turn-tables and sidings, and in docking at the termini of the railroad, will exceed the detentions at the few locks of the canal. He criticises the estimate of Colonel McFarland, of $140,000,000 for the canal, and also the opinion of the same officer as to the Harbor of Greytown, quoting, in opposition, the estimates of commissions appointed by the Paris Canal Congress. He states that the dividends paid by the Suez Canal in 1883, after a large reserve for improvements, was 17.3 per cent.; that the business of that canal is increasing to such an extent that steps are to be taken for its enlargement, or for the building of a new one at an estimated cost of $40,000,000. He refers to the fact that the Isthmus of Suez is a level plain, 100 miles wide, and sixty-five one hundredths the length of the Tehuantepec Ship Railway. The cost of the Suez Canal was $95,000,000, or $20,000,000 more than Mr. Corthell's estimate on the railway rising to an elevation 720 feet above the sea. He asks whether it is to be supposed that a proposition would be seriously considered to build at that isthmus a ship railway to take the place of a new canal, or of the present one when enlarged.

Mr. E. L. Corthell, M. Am. Soc. C. E., replying, states that he is convinced of the thoroughness of Col. McFarland's report, and presents a letter from that officer, with a copy of his report. This report was made in 1874 to the United States Interoceanic Canal Commission, consisting of the Chief of Engineers of the Army, the Chief of the Bureau of Navigation of the Navy, and the Superintendent of the Coast Survey. Col. McFarland was detailed, at the request of that Commission, to make an examination and to report upon the projects for the canal at the Isthmus of Darien and the canal at Nicaragua. In this report there is given an estimate of the cost of the Nicaragua Canal of $110,000,000, on the basis that as much work will be accomplished by a laborer there as in the same time by a Northern laborer, and that this work costs one dollar. But he considers that the item of labor should be estimated, on account of the locality, at an increase of $30,000,000, and that therefore the probable cost for opening this route is $140,000,000, which he states to be at the rate of $772,000 per mile, inclusive of locks, while the Suez Canal cost a little less than $1,000,000 per mile.

DECEMBER 16TH, 1885.—A paper by Capt. F. V. Greene, United States Engineer, M. Am. Soc. C. E., on Street Traffic, was read. The object of the paper was to call attention to the large sums invested in street pavements—amounting to about $250,000,000 in the twenty principal cities of this country; to explain the desirability of keeping systematic records of the traffic over the various pavement, and their wear under this traffic; and to describe certain observations upon traffic recently made under the writer's direction. After referring to the observations made by Haywood and others, in London, by Deacon, in Liverpool, and by the French engineers in Paris, the writer described in detail the manner in which his own observations were taken. In brief, they were first recorded by one or more observers by the punch and "trip slip" method in use by car conductors, slips of different colors being used for vehicles of different tonnage. A summary of each hour's observations was then transferred to a daily report made on a printed form. These were then sent to the writer, by whom the computations of total tonnage, tonnage per vehicel and tonnage per foot of width, were made. The observations were continuous from 7 A. M. to 7 P. M. on six consecutive days at each place. The accidents to horses were also observed and recorded, in three classes, viz.: falls on knees, falls on hunches, and complete falls. Record was also made of the width and grade of the street, state of the weather, temperature of the air, average speed of the vehicles, and length of street on which accidents were observed and recorded. On the back of the printed form of report, full instructions were given for the observers, especially in regard to the weight of different kinds of vehicles, and every precaution was taken to have the observations made on a uniform system, and to eliminate the personal equation of the observer and leave as little as possible to his judgment. Each day's report was subscribed and sworn to by the observers before a notary public. These reports were submitted to the members present for their examination. The observations were made on 36 various streets in 10 different cities, viz.: New York, Philadelphia, Chicago, Boston, St. Louis, New Orleans, Washington, Buffalo, Louisville and Omaha. The pavements on the streets observed were of granite, asphalt and wood.

In compiling the results as to traffic, the standard for comparison was the average daily tonnage per foot of width. This was found to range from 273 tons on Broadway, in New York, to 7 tons on Olive street, in St.

Louis. The average weight per vehicle varied from .68 tons on Fifth avenue, in New York, to 2.08 tons on a part of Wabash avenue, in Chicago. Several remarkable instances were given of the manner in which smooth asphalt streets have drawn the traffic away from stone pavements—the most noticeable instance being in St. Louis, where, on Olive street, paved with granite, the daily traffic per foot of width is only 7 tons, while on Locust street, paved with asphalt, it is 103 tons, the two streets being parallel, adjacent and similar in every respect, and paved at the same time. Comparison was also made with the London observations, showing a very much larger traffic (as high as 422 tons on one street) in the latter city, and the cause of the difference was stated to be the absence of street cars and the large number of cabs and omnibuses thus rendered necessary. Reference was also made to the observations by Messrs. Deacon and Stayton, in England, on the comparative wear of different classes of pavement under different amounts of traffic as actually observed; and the desirability of keeping such records by municipal engineers in this country was pointed out.

In regard to accidents, the standard for comparison was the "distance traveled before an accident occurred." This was obtained by multiplying the distance over which observations were recorded by the number of horses, and dividing the product by the number of accidents. The general result was: on asphalt, 583 miles; granite, 413 miles; wood, 272 miles. There were only three sets of observations on wood, and, hence, as to this class of pavement, the results are inconclusive. As to granite and asphalt, the large number of observations (over 800,000 horses and 81 000 miles traveled) justified the conclusion that fewer accidents occur on asphalt than on granite.

This agreed with the result of similar observations in London, although in the latter city, from local causes, the accidents on each class of pavements were about three times as numerous as in the cities observed in America. In classifying the accidents, the falls on knees were found to be much more numerous on granite pavements than on asphalt, whereas the falls on haunches were more numerous on asphalt than on granite. The cause of this was pointed out, the granite blocks being too wide (about 5 inches instead of 3) to afford a proper footing for the horse; and the fall on haunches on asphalt being due to sudden pulling up or turning of the horses, as noted in nearly every case in the reports.

QUESTIONS AND ANSWERS.

J. M. R. Bedford, Pa. Will you please state for my information what are the essential features of the "Holly System" and, if the system is patented, if a royalty is demanded for its use.

[The Holly Manufacturing Company issue a pamphlet of 68 pages in which is a good deal of information respecting various systems of water works. On page 7 of this pamphlet is the following:

"The essential features of the Holly System are:

1st. Direct pumping into the mains, and consequent saving of the heavy cost of distributing reservoir or stand-pipe.

2d. Self-regulation, to accommodate a fluctuating demand, thus saving fuel and wear of machinery and piping.

3d. Prompt and efficient fire supply. Water delivered in powerful streams to the extent of corporate limits, and the expense and maintenance of a fire department saved.

4th. Large reduction in insurance rates effected."

The Holly system is patented, but no charge is made for its use provided the Pumping Machinery is bought of the Holly Manufacturing Co. The office of the Company is at 44 Broadway, N.Y. C. G. Hildreth, Secretary.]

H. M. Will you please send us subscription list for the different periodicals, quoting us, subscribers to the Engineering News reduced rates on the periodicals. We have not received one from you this year and wish to send in quite a number of subscriptions to magazines.

[In answer to the above we wish to call special attention to the advertised rates on our editorial page. At the same time we wish also to call attention of subscribers to the printed label on each number of their paper; it is changed in date of expiration on receipt of subscription and is a valid acknowledgment of the same. Unless specially requested we will not send receipts for subscriptions. Please see that the printed label is correct.—Ed. Eng. News.]

O. M. W. Will you kindly advise me in your next issue, what work on "Architecture" a beginner should use?

[We can hardly answer but would advise getting a catalogue of Architectural Books from W. C. Comstock, Astor Place, N.Y. and also enquire there.]

W. W. K. Please tell me what are the best books on R. R. location. I do not refer to the fitting of curves, etc., the discussion of the comparative advantages and disadvantages of several lines. Giving the effect of curves, heavy grades, extra length necessarily caused by curves, and how much extra money per mile can be spent to build a line much straighter, cutting out curves, etc.

Isn't there a work "Wellington on Location?" Is that what I want, and what is the price?

[Wellington's "Economic Location of Railways" is the *only book* to buy. The first edition is out of print and has the remarkable record of having sold from $2.00 up to $20.00, the latest quotation and none to be had at that. The second edition has been entirely re-written by Mr. Wellington, who has embodied his practical knowledge of the past years of active railroad locating in this country and Mexico, and the copy will soon be in the printer's hands. We do not yet know the price or how soon the new edition will be issued to the public, but it will be some months hence. We have had some hundreds of applications for the book, to be filled as soon as possible, and we will be glad to add your name to the list. No money must be sent us until we duly announce the date of issue and the price of the book. It will be a work which no railroad engineer will do without; especially on the eve of an active period of railway locating such as is now "almost in sight."—Ed. Eng. News].

CORRESPONDENCE.

Fast Telegraphing.

Office of Mickle & Lea,
Civil Eng. and Surveyors, 817 Water St.
Selma, Ala., December 18, 1885.

Editor Engineering News. *Dear Sir*:—In your issue of Engineering News for November 21st, 1885, occurs the following statement:—"London then cabled to New York at five P. M., and the dispatch was received in New York about twelve noon the same day, or *five* hours earlier than London. New York then wired to the San Francisco correspondent (five hours earlier than New York)." In another place the distance from San Francisco to New York is given as 3,000 miles, and from New York to London as 3,000 miles also. Now as the sun's shadow travels over fifteen degrees of arc per hour, and the distance from London to New York or from New York to San Francisco is given as 3,000 miles, the difference in time between two of the above named places would manifestly be three hours.

The actual difference in time between New York and San Francisco is about three hours ten minutes.

Yours truly, S. H. Lea.

Illinois and Indiana News.

Champaign, Ill., January 4, 1886.

Special Correspondence Engineering News.

Your correspondent returned from New Orleans on Saturday night, and we will send you some exhibition notes as soon as they can be arranged. The following items we have hastily gleaned from our exchanges:

Joseph O. Lizelman, a contractor of Newton, Jasper county, Illinois, has disappeared.

A company has been organized in Indiana, to stock the long unused Wabash and Erie canal with carp.

The city of Henry, Ill., has sunk an artesian well, which gives them 700 gallons of water per minute. The well is 750 feet deep.

The Pullman shops near Chicago have orders from the New York Central Company for forty sleeping-cars and fifteen drawing-room coaches.

Petersburg, Ills., is ready to receive propositions for furnishing that city with water for fire and domestic purposes.

The Jenny company are erecting an extensive electric light plant for Decatur, Ills.

The citizens of Effingham, Ill., are making preparations for drilling for coal, with a determination to find it or prove conclusively that there is none.

P. H. Faught, of Gibson, Ills., has just been awarded the contract for the Union Drainage District ditch in Ford and Livingston counties, Ill.

Col. Waring, of Newport, R. I., is engaged in surveying and preparing plans for a general sewerage system for Danville, Ill.

The County Commissioners of Fountain county, Ind. have been petitioned to build a highway bridge across coal creek on the road between Covington and Pleasant Hill. This county spent $143,000 for bridges during 1885.

Lincoln, Ill., has just entered into contract with Hinds, Moffett & Co., Watertown, N. Y., for city water works capable of furnishing 1,000,000 gallons in twenty-four hours, with the ability to give a pressure equal to 200 feet head of water, the tower to be not less than 154 in diameter, wrought-iron. There are to be five miles of pipe from 12 to 4 inches in diameter. The city pays $60 each for 50 hydrants, the company keeping the hydrants in repair. Water is to be furnished free to the city offices and the schools and to five fountains, one of which is to be run continually. Water is to be furnished free for flooding the gutters and streets for sanitary purposes. The city may order an extension of the present works at the same rates; additional fire-hydrants may be placed on the original mains at the expense of the city, but without any charge for the water. The franchise granted is for thirty years, but the city has the right of purchase at the end of the first ten years, and at the expiration of each subsequent period of five years.

Nebraska News.

Omaha, Jan. 2nd, 1886.

Special Correspondence Engineering News.

The following appointments on the N. P. R. R. have been announced, to take effect January 1st, 1886:

Mr. C. H. McKibben, Chief Inspector of Supply Department, with headquarters at Omaha, Nebraska. Mr. E. H. Barnes, Division Engineer, Colorado Division, with office at Denver, Col., vice J. H. Collins, resigned. Both the appointees are from the Pennsylvania R. R.

The bids for the new iron viaduct over the U. P. and B. and Mo. tracks for Eleventh St. Omaha, will be opened and canvassed the 9th of January.

The plans for a wooden viaduct over the same track for Sixteenth St. are now being prepared at the office of the City Engineer.

Ashland, Nebraska City, and Hastings, Neb., are talking of having water works, but no definite action has been taken on the subject.

WATER

The Commom Council of Buffalo, N. Y., has voted $250,000 for a sewer for the via Appia of that city.

At Hanover, Germany, works have been erected to manufacture the sewage of the city into a fertilizer. The process is free from all nauseating smell. The fertilizer will be very valuable, as it will contain from 3 to 3½ per cent. nitrogen, 3 per cent. phospaoric acid and 3 per cent. potassium.

The city of Kief, Russia, desires to put in a system of sewerage, and the firm of Wurzinger & Comp, of that city, would be glad to receive the names of competent sanitary engineers with whom they may enter into correspondence. By the by, what has become of the Victoria, British Columbia, sewerage scheme?

A meeting of the New Lots Board of Health was held recently in the Town Hall, for the purpose of obtaining the views of taxpayers on the question of introducing a proper system of sewerage for the town. All present expressed themselves heartily in favor of such an improvement.

Newburg, N. Y., Dec. 15.—The General Term has affirmed the decisions of the Supreme Court in the cases of Julia and George D. Turner against the city of Newburg. The decisions ratify a judgment of $3,500 against the city in one case and of $1,000 in the other. Mrs. Turner brought suit for the recovery of $10,000 for injuries received in falling, owing to a defective crosswalk, in October, 1883, and her husband sued for the same amount for the loss of the services of his wife and the loss of her companionship while she was suffering from her injuries. The case will probably be taken to the Court of Appeals.

The sanitary condition of Fall River, Mass., has been greatly improved by sewer works. About $168,000 has been expended upon them, and on an average 550 men have been employed since last May, when work was begun. The sewers have all been laid in accordance with plans previously laid down by experts, and where the depth has in some cases been criticised as unnecessary, the authorities reply that it could not have been avoided. The work was actually completed on December 19 th.

Milwaunee, Dec. 23.—A few weeks ago the city granted a franchise to the Dorsett Underground Service Company to establish an extensive system of conduits, and the initiative steps were taken for putting in a $500,000 plant. It now developes that an agent who had been given power of attorney to dispose of the company's stock had made a sale to an opposition company of whose conduits little is known. The Mayor has declined to approve the bond of the new stockholders and legal action will be taken by the Dorsett people. It is likely that at the next meeting of the city authorities the company's franchise will be revoked, should no other way be presented for blocking the conspiracy against the original company.—*N. Y. Tribune.*

Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, DEC. 1885.

Town. State.	Topography.	Difference of level in town.	In Business District.		
			Day Pressure.	Night Pressure.	Fire Pressure.
		feet.	lbs.	lbs.	lbs.
Adams, Mass.	hilly.	85	110	125	110
Akron, Ohio.	hilly.	50	95	100	95 to 100
Alton, Ill.	very hilly.	100 to 150	85 to 105	85 to 105	125 to 140
Amesburg, Mass.	hilly.	40	60	60	100
Amherst, Mass.	hilly.	0	100	100	100
Amsterdam, N. Y.	hilly.	100	90	90	133
Andes, N. Y.	hilly.	none.	not given.	——	——
Anniston, Ala.	rolling.	20 to 50	85 to 95	75 to 85	85 to 95
Ansonia, Conn.	hilly.	100	80	90	90 to 120
Appleton, Wis.	level.	35 to 45	70	60	100 to 130
Archbald, Pa.	level.	20 to 100	90	90	90
Ashland, Pa.	hilly.	on slope.	120	——	——
Atlanta, Ga.	hilly.	——	40	40 to 50	90 to 120
Atlantic City, N. J.	level.	5	45 to 50	45 to 50	45 to 50
Attica, Ind.	hilly.	125	50	——	45
Attica, N. Y.	nearly level.	5 to 10	62	62	——
Auburn, Me.	hilly.	43	52	55	100
Auburn, N. Y.	hilly.	40	30	40	80
Augusta, Ga.	level.	0	35	35	65
Augusta, Me.	hilly.	100	61 to 65	61 to 65	61 to 65
Avon, N. Y.	hilly.	50 to 80	30	45	90
Bainbridge, Mass.	level.	72	28	——	28 to 48
Bainbridge, N. Y.	level.	——	115	115	115
Ballston Spa, N. Y.	hilly.	52	30 to 50	50	36
Batavia, N. Y.	level.	0	40	35 to 40	100 to 150

TIFFIN, O., has struck gas.

MUSKEGON'S, Mich, artesian well is down 550 feet.

CALDWELL, Kan., has now got water works in her mind.

THE Missoula, Mon., Water Works and Milling Company has been incorporated with a capital of $70,000

PARKHILL, Ont., Jan. 2.—Pure petroleum have struck near here at a depth of 175 feet.

THE Thomasville, Tenn., Gas Works Company, has been organized, with A. P. Wright president.

THE artesian well at the Chemical Works, Augusta, Ga., is now boring through granite, and a depth of 100 feet has been reached.

THE drinking water furnished to the people of Columbia, S. C., is abominable. Many citizens are talking about having an artesian well.

THE fourth successful gas well has just been completed at Monticello, Pa., three miles above Kittanning, for the Kittanning Caloric Company.

THE National Water Works Company has purchased the Wyandotte water works and as soon as arrangements can be made Kansas City will be supplied with water from the Missouri river.

THE soundings for the new submerged water pipe across the river at Minneapolis show that but little dredging will be necessary to secure a substantial and safe bed.

THE Cincinnati Board of Public Works has received with the Mayor's signature the bill contracting to supply Clifton with water. The board formally concurred in the bill, and it is now a law.

THE laying of water pipes in Hillsdale, Mich., has been completed. There are in the city 64 hydrants, 1,854 feet of 4-inch; 22,418 feet of 6-inch; 4,214 feet of 8-inch; 3,480 feet of 10-inch,and 6,917 feet of 12-inch pipe, or a total of 7.3 miles.

A GAS well has been struck at Miller, in the Ohio valley, at a depth of 1,000 feet, which is estimated to have a pressure of 400 pounds per square inch. The roar of the escaping gas can be heard for miles around.

THE report of Engineer Curtis of the pumping station in Middleton, Mass., of the work done for the month of December, is as follows: Working time, 173¼ hours; number of pounds of coal consumed, 44,231; number of gallons pumped, 12,525,480.

THE Howard well at New Orleans is now 985 feet deep, and Mr. M. T. Chapman, the contractor, states that good water has been struck. It is is not of sufficient volume or purity, however, and the well will be driven deeper. When the well was 976 feet deep, a strata of ocean sand was struck.

HARRISBURG, PA., Jan. 4.—Charters were issued by the State Department to-day as follows: Onex Land Improvement Company, of Philadelphia; Haverford Water Company, Radnor Water Company, Springfield Water Company, Lower Merion Water Company, all of Delaware County.

THE city authorities of Paris, France, have applied to Secretary of State Bayard for information relating to the drinking waters of this country. In answer to a communication from Mr. Bayard, Dr. Memminger of Charleston, N. C., has sent in a report on the waters of that city. These waters, Dr. Memminger says in his report, are embraced under three heads: First, those obtained from cisterns and termed cistern water; second, those derived from shallow wells and consequently known as well water; and, lastly, those derived from deep wells, which are known as artesian water. He says: "The artesian waters have received my most careful attention from a sanitary standpoint, and it is most gratifying for me to state that they come well up in the class of 'good waters' and, if proper measures are bestowed for the well-keeping of our system of mains, as also the settling basin, there would be no need of complaint from this class of waters, which from a chemical point of view, are the only real available supply for the poor of this city."

The report contains several analyses of water from different parts of the city.

MINNEAPOLIS PROGRESS.

	1885.	1884.
No. miles of new street pavement	3¼	3¾
No. miles new streets graded	50¾	16¾
No. miles new sewers laid	8¾	6¼
No. miles water mains laid	13¼	10
No. miles new sidewalk laid	45¾	25
No. miles new gas main laid	10	13¼
No. miles new electric light line hung	80	80
No. miles new street car track	4	17½
Expended by the city for improvements	$1,591,011	$926,553
Expended by public corporations for improvements	$1,713,000	$1,470,000
Expended by park commission for parks	$509,702	$179,584
Total expenditure for new buildings	$8,484,165	$7,621,950
Population	129,200	114,000

SPRINGFIELD, MASS.—The water commissioners' 12th annual report is in substance as follows: Construction—appropriation for extending water mains for 1885, $13,000, charged to construction $11,927, making total cost of works to date $1,306,187, and leaving a credit balance of $1,760. Of cast-iron pipe, 15,064 feet have been laid and 5,365 feet of sheet-iron cement-lined pipe taken out. This is a net addition to the high-service pipe of 8,377 feet and to the low of 1,322, making the total length seventy-five miles. Gates, fifty-three set, twenty-two taken out; total now in the works, 654. Fire hydrants, forty-nine set, twenty-six taken out, 457 now in use, of which 297 are high-service and 160 low. There are also sixty-seven fire hydrants located on private property, making a total of 524 connected with the works. In extending mains, setting gates, hydrants, etc., $11,235 was expended. Maintenance—relaying the 24-inch main pipe under the Boston and Albany Railroad tracks, $1,204; relaying t e 2,504 feet 12-inch main on Main street, $4,986, and the six-inch on Greenwood street, $917; for salaries, teams, labor, materials, etc., $15,029 was expended; total for maintenance, $22,136. More than $7,100 was expended in taking up the sheet-iron cement-lined pipe and replacing it wi h cast-iron, which should be continued until the entire 45.75 miles of such pipe is replaced. Quality.—The Ludlow water, while not at all times what could be wished, has been an improvement in quality over that of any previous year. Still it carries at its best a considerable amount of vegetable matter in suspension requiring tanks and hot water boilers to be frequently cleansed if consumers wish to avoid offensive odors. Its color and appearance at the reservoir has been very fair. The daily use of water is about 3,000,000 gallons, or seventy-nine gallons per capita, a quantity undoubtedly larger than our legitimate uses.

CONSUMPTION.

Estimated population	38,000
On lines of pipe	33,000
Supplied	29,000
Gallons consumed during year	1,095,000,000
Passed through meters (5½ per cent.)	60,308,752
Average daily consumption	3,000,000
To each inhabitant	79
To each consumer	104
To each tap	707

MAYOR BANKS of Albany, N. Y., has vetoed the Common Council's ordinance for the driven well system of water supply for that city.

THE Montgomery Water Works, Col. Troy, President, have just contracted with Edward P. Allis & Co., Milwaukee, for one of their Reynolds compound, condensing, vertical pumping engines, of three million gallons capacity.

SOUTH BRAINTREE, MASS., December 30th.—At the town meeting to consider the matter of accepting the act of the Legislature to supply Braintree with water, it was accepted by a vote of 237 for, to 92 against.

A handsome heliotype illustration of the New High Service Pumping Station for the Cleveland Water Works is given in the *American Architect and Building News* of January 2nd, 1886. The height of the tower is given as 240 feet. F. C. Bate, of Cleveland, was the architect. The building cost $100,000.

N. R. HOOK, formerly a manufacturer of tiles, writes from Fremont, Ia., to the *Drainage and Farm Journal*: "Drainage will have a big boom here next year. But Mr. Hook is "going West" to Lincoln, Neb., and writes: "they are enjoying a genuine boom out there. The city of Lincoln has built this year 1,000 buildings, and everything is humming."

THE Sing Sing Board of Trustees, at their meeting on Tuesday evening 5th, granted a franchise for one year to Messrs. Knight & Thompson, contractors, to make preliminary surveys in the vicinity of that village with the purpose of building water-works for that place. It is probable the water will be derived from the Croton River at a point a short distance above the location of the proposed Quaker Bridge Dam.

FROM the Long Branch, N. J., *News* of last week, we learn that the "Long Branch Sewage Co.", have at length decided upon a system of sewerage for that city, and measures for its immediate construction have been adopted. Messrs Bassett & Nute, of Newark, N. J., are the engineers to prepare the detailed plans and superintend the construction, bids for which will soon be advertised in this journal. The principal feature of the scheme is that the sewage is to be utilized and no offensive material is to be allowed to pollute the natural water courses on the waters of the Atlantic. Plans and drawings may now be seen at the office of the company at Long Branch. The following officers have been elected: *President*, Dr. S. H. Hunt; *Vice President*, Dr. Jno. P. Pemberton; *Treasurer*, Philip Daly, Sr.; *Secretary*, J. E. Green; *Superintendent of Construction*, R. V. Breece; *Counsellor*, Wm. D. Compbell.

NEWS OF THE WEEK.

CONTRACTING.

There is no single class journal in the United States read by so many contractors for all kinds of Civil Engineering construction as ENGINEERING NEWS AND AMERICAN CONTRACT JOURNAL. *We propose as in the past to publish early intelligence of all new contract work. Our prices for advertising proposals for contracts is twenty cents per line, and it is so cheap that parties having any work to advertise will always find it a good investment to use this journal.*

A Contractor's Claim.—Mr. J. P. Cranford, Contractor claims $15,000 for extra work on a sewer in Brooklyn. The Mayor will be arbitrator in the case and the Contractor has consented to accept his decision.

Girder Rails.—O. W. Mysenburg & Co., Western agents of the Johnson girder street rail, have closed a contract with the St. Paul and Minneapolis systems of street railway for 1,500 tons of that rail, spring delivery; also one with the Benton and Bellefontaine line, of St. Louis, Mo., for 200 tons of the same rail.

Excavation.—The contract for excavating the earth and removing the hill on Southbridge street, at Worcester, Mass., which is to be occupied for the new Norwich & Worcester freight depot, has been awarded to Thomas Manley, of Boston.

New Buildings.—Ehrich Brothers have filed plans and specifications with Superintendent D'Oench for the construction of a building at Nos. 361 to 371 Sixth avenue, Nos. 110 and 112 West Twenty-third street, and Nos. 109 to 117 West Twenty-second street, to cost $300,000. The property is owned by Josphine A. Harding, Newman Bocklowitz, Jane A. Wolfe, D. J. A. Price, Henrietta Kerr, and Ehrich Brothers. The structure will be five stories high, with a flat roof, and the plan of the façade shows vast window space in order that the interior may be well lighted. The materials of the front will be brick and freestone. A Zucker & Co. are the architects.

Norfolk Harbor Improvements.—We learn from Capt. F. A. Hinman, the engineer in charge, that, on 22d inst., P. Sanford Ross, Esq., finished his contract to remove 469,944 cubic yards of material, measured in scows, from the approach to this harbor between Lambert's Point and Fort Norfolk.

This work has resulted in a straight channel the entire length (about two miles) of said reach, at least 400 feet wide and 25 feet deep at mean low water (it is much wider at the ends).

Three spar buoys have been placed in a straight line to mark the eastern edge of this channel, and it is for the good of shipping interests that they be kept there intact.

It is very gratifying to hear that this work has been done to the entire satisfaction of all concerned. It was finished nine days sooner than the least time (three months) allowed by the contract for its execution.

No further government work will be done in this harbor until another appropriation is made. Norfolk, Va., *Landmark*.

To Check Drunkenness on the Croton Aqueduct.—About the middle of December, the Aqueduct contractors named issued the following circular:—

ADDITIONAL RULES AND REGULATIONS.

In consequence of the largely increased expense of running our machinery immediately after each pay day, while the laborers remain away from the work, by reason of drunkenness or otherwise, and for the better protection of life and property, the following schedule of wages will be in force, commencing on the 21st of the present month:

For all employes making full time the present rate of wages will be maintained. For fractional time a deduction will be made as follows: Drill runners, 50 cents a day; helpers, 25 cents a day; muckers, 10 cents a day, and all other employes in proportion.

We had anticipated reducing wages on the line, but as steady work is so valuable and important to us, we feel that an extra inducement should be offered. Consequently men who remain constantly at work during the months will have the advantage of the present high wages.

HEMAN CLARK.
O'BRIEN & CLARK,
Contractors.

YONKERS, Dec. 16, 1885.

The daily wages on which the above rules are based were, for drillers, $2.50; helpers, $2.00; muckers, $1.50 The men do not take kindly to this new order of things, and look upon it as an attempted interference with "their rights." As the regulations are now in force, some trouble may be expected.

Railroads, Bridges and Canals.

Quite Metropolitan.—It appears that Vermont's only horse-car railway is a big success. A Rutland paper says: "There were two horse-cars running all day, and the tinkling of bells and the roar on the track had a really metropolitan sound."

Baltimore and Ohio Plans.—The offices of the Baltimore and Ohio Railroad Company say that they hope to have their line through Philadelphia, built and in operation not later than May. In the meantime they are making surveys to different points in the city with a view of securing a large collateral business.

Iron Bridge Finished.—The iron bridge over White Oak Creek on the Cincinnati, Georgetown & Portsmouth R. R. (narrow gauge) has been finished. It is one thousand feet long, and with sixty foot spans. It is one hundred feet high above the foundation, and is strong enough for a standard gauge track and equipment. The piers are of iron on stone foundation. It has cost between $50,000 and $60,000.

The Atlanta Bridge and Iron Works, which shut down last spring on account of the embarrassment of the firm of Wilkins, Post & Co., who run the works, is about to be put upon its feet again. A proposition was made to organize a corporation in which each creditor would take stock to the amount of his claim. Committees were appointed at a meeting to obtain a charter and to induce creditors to take the stock. At a recent meeting at which nearly all the creditors were present or represented, the charter was accepted and a corporation organized under it, to be known as the Atlanta Bridge and Iron Works.

The Atchison, Topeka and Sante Fe Railroad, has submitted a township and city bond in Cowley county, Kan., to aid in the building of twenty-two miles of road between Douglass and Winfield. Under authority granted this company to build from Arkansas City into the Indian Territory, it is required to construct a hundred miles during the present year. The surveyors are in the field, and work on this Indian Territory line will begin in early spring. Township bond propositions are to be submitted in Chase and Butler counties to aid in building a cut off between Emporia and Eldorado, which, when built, will place Kansas City, Emporia and Arkansas City in an almost air line.

A Napoleon in Texas.—The Kerrville (Texas) *Eye* says: "That Civil Engineer in the *Express* of Wednesday says, there are no 'minature Alps' to bore through to reach Fredericksburg. Lot's charts and preliminary survey records say they are! But perhaps Wentworth's skill as an engineer warrants him in exclaiming as did the great Napoleon when about to invade Italy, one of his generals ventured to remark, 'what about the Alps?' when the great warrior exclaimed: 'There shall be no Alps. Get your people to take up $6000 of bonds per mile, gentle Wentworth, and there will be no Alps."

The Baltimore and New York Railroad Company was incorporated on the 5th inst. The road, which is the B. & O. R. R's. Jersey link, will begin at a point on the Rahway river, in Clark township, Union county, about a mile north of the city of Rahway and will terminate at a point on the eastern line of the State of New Jersey, in Union county, at a point near the mouth of Morse's creek and opposite the city of Elizabeth. The length of road will be six miles. The whole number of shares is 10,000 at a par value of $100 each, making the amount of the capital stock $1,000,000. In addition to this road the company will have to secure a bridge across Staten Island Sound, as generally understood.

The Omaha and North Platte Railway Company has filed articles of incorporation in the County Clerk's office at Omaha, Neb. The corporation was formed last October, and the following Directors were elected: G. W. Holdrege, J. G. Taylor, C. O. Damon C. Green, and P. S. Eustis, of Omaha; J. S. McFarland and T. M. Marquette, of Lincoln. It is said that the road is in the interest of the Burlington; it will run in a southerly direction from Omaha, and will connect with the Grand Island and Wyoming Central R. R., with branches extending to Fremont in Dodge county, and Norfolk and Madison counties. The capital stock of the company is $5,400,000, and operations will be commenced as soon as 10 per cent. has been paid in.

New Line Along the Palisades.—Articles were filed in Albany on the 4th, incorporating the New York and Palisade Railroad Company. It is to run from this city along the top of the Palisades, as near to the brink as may be practicable as far as Nyack. This route will take the road through Piermont and Sparkill and near Fort Lee. It is entirely independent of the West Shore or any other road, and is run largely to bring Nyack into proper communication with the city. Its incorporators are Appleton Morgan, of No. 21 Park Row, J. E. Reynolds and E. Leavitt, jr., of New York, and G. A. Lawrence, M. F. Onderdonk, R. J. Lyeth, Peter Richling, W. W. Hinton, D. Morris, Dr. E. H. Powell, and A. J. Brainard, of Nyack. The capital stock is $250,000, all of which, the company says, is paid in. It will be about five miles long, and the work of construction will go on as soon as the spring opens. An election of officers will take place at the next meeting of the stockholders. It is expected that Mr. Morgan will be president; Mr. Leavitt, vice-president; Mr. Reynolds, treasurer; George L. Baker, secretary, and C. V. W. Fonda, chief-engineer.

The Argentine Republic Government, has formally accepted the propositions of Mr. Gonzalez for the improvement of the harbor at Buenos Ayres and extension of the interior lines of railway.

Savannah, Dublin & Western Short Line R. R. A corps of surveyors has started from Savannah on a preliminary survey for the proposed Savannah, Dublin and Western Short Line Railroad. Another corps has started from Dublin.

The Chicago, Kansas & Nebraska R. R is a company to extend the main line of the Rock Island road 400 miles into Kansas and to construct short lines from Larkin to Atchison and St. Joseph, so as to make river-connections at these two points. The capital stock is $15,600,000.

The Canada Atlantic Railway, running from Ottawa, Ontario, to Rouse's Point, N. Y., with a steam ferry for cars across the St. Lawrence river, has been sold to the Canadian Pacific Railway Company, which will use a portion of it in forming its projected air line from Smith's Falls to Montreal. The Canada Atlantic has hitherto been operated in connection with the Grand Trunk.

The Canadian Pacific Railway.—Mr. Middleton, one of the Canadian Pacific engineers, has commenced locating the air line from Smith's Falls to Montreal which, when completed, will greatly shorten the distance to Toronto by the Canadian Pacific Railway. The line is to pass through the townships of Montague, Oxford, South Gower, Winchester, Finch, Roxborough, Kenvon, Lochiel, Longueuil, Soulanges, and Vaudreuil and the villages of Winchester and Crysler.—Montreal *Gazette*.

The Huntington Roads.—These roads, with an aggregate mileage of 1,828 miles, are to be under one general management. The Maysville and Big Sandy road will be extended from Ashland, Ky., to Cincinnati it is year. This will shorten the distance about sixty miles. The missing link in this through system, between Lexington and Louisville, will be built unless the existing road between these points can be bought at a satisfactory price. It is said that Mr. Huntington has his eye on the Louisville, Evansville and St. Louis road, which would give him a line into St. Louis with the aid of the Louisville and Nashville.

Northern & Pacific Junction R. R.—Surveys of this almost completed railway were begun in 1873, but it is to the energy and ability of Mr. J. C. Bailey, C. E., of Toronto, formerly chief engineer of the Credit Valley R. R., that an excellent alignment was finally obtained and the road built. The new line joins the Canadian Pacific at a point called La Vase, distant by the present route, from Toronto 440 miles, but by the N. & P. J. R. R., only 226 miles. The new road begins at Gravenhurst and runs 111¼ to the Canadian Pacific Railroad Junction at La Vase. Construction commenced in September, 1884. There are a number of bridges, mostly Howe truss, besides trestles and viaducts, from spaces of 400 feet down. They were built by the Hamilton, Ont., Bridge Works.

The construction of the entire works devolved on J. C. Bailey, chief engineer, of Toronto, Ont. The resident engineers in charge of construction were Messrs. W. L. Mackenzie, J. A. Paterson, J. H. Barber, and D. S. Noble, with a staff of assistants both on the works and in Toronto. The chief contractors of the road were Messrs. Hendrie, Symmes & Co., and the principal sub contractors, Malcolm & Ross, Booth and Cosgrove, Robinson Brothers, Angus McDonald, D. R. Macdonald, Breen & Conolly, John Essen, Drew & Gibe, Morse Brothers, McDonald & Heald, James Hendries McKenna & O'Brien, Kennedy & Corbet, Kirky & McKay, Deany & Halliday, and Kelpin and T. Arbuthnot. Fully two thousand horses were engaged on the railway. The laborers, who numbered 3,000, were principally Italians, with some Swedes, Finlanders, Icelanders, Hungarians, and a few Greeks. No preference was, however, given to any nationality. They were hired as they came, without any questions asked. It is expected that the road will be ready for traffic in February. The Canadian Pacific Railway has two Pullmans ready to run over the road to Toronto as soon as the company are notified that the line is ready for use.

Market Report of Engineering Materials.

New York, January 7, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.	
Angles	1.95 @ 2.00
Tee	2.25 @ 2.35
Beams and channels American	3.0c. @
Tank	2. @ 2.1c
Shell	2.4c. @ 2.5c
Special plates, Tank	2½c. @
WROUGHT-IRON PIPE., PITTSBURGH.	
Butt welded, black.....Discount	43½ @ 45
" " galvanized..... "	32½ @ 35
Lap welded black..... "	60 @ 62½
" Galvanized..... "	45 @ 42½
Boiler tubes	55
RAILS.	
Steel (large lots at mill)	35.00
Old rails	21.00 @ 22.00
Old railsteel	19.00 @ 20.00
R R. spikes	2.25
R R. splice-plates	1.70 @ 1.75
R R. Track Bolts Square Nuts	2.75
Barb-wire fencing, galvanized	4.75
" " painted	3.75
Corrugated iron	
Nails	
Iron, per keg	2.65 @ 2.75
Steel do.	2.50

METALS.

COPPER.	
Lake Superior	11.45 @ 11.65
Other Brands	10.35 @ 10.70
LEAD.	
Com. Domestic	4.65 4.70
Lead Pipe	.06¾
Tin-Lined Lead Pipe	.15
Sheet Lead	.07¼
ZINC.	
Sheet	5.15 @ 5.45

BRICK.

Cargoes afloat)	
Haverstraw.....per M.	$7.25 @ 7.50
Fishkill	
Up-River	6.25
Jerseys	6.00 @ 6.75
Long Island	
" pale	3.25 @ 4.00
FRONTS.	
Croton, red	11.00 @ 14.00
" dark	11.00 @ 14.00
" brown	10.00 @ 13.00
Philadelphia pressed	24.00 @ 25.00
Trenton "	24.00 @ 25.00
Baltimore "	37.00 @ 41.00
Buff "	33.00 @ 35.00
Enameled English	65.00 @ 130.00
" American	85.00 @ 120.00
Fire brick	24.50 @ 55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50 @ $3.00
BAETJER & MEYERSTEIN:	
Hanover Portland	2.60 @ 2.65
BELLONI & Co.:	
Hemmoor "Crown" brand	2.50
JAMES BRAND:	
K. B. & S	2.55 @ 3.00
BROOKS, SHOOBRIDGE & Co.	2.45 @ 2.60
HOWARD FLEMING:	
Gibbs' English Portland, 400 lbs	2.65 @ 2.90
K. B. & S. " "	2.75 @ 2.95
Stettiner, German	2.65 @ 2.85
Lagerdorfer, "	2.45 @ 2.75
Fleve, A 1, Belgian	2.35 @ 2.50
Roman	2.75 @ 3.00
Keene's Coarse	4.75 @ 5.50
" Fine	7.75 @ 8.50
" Superfine	8.50 @ 10.00
FISHER, ERSKINE W.:	
Stettin (German) Portland Cement	$2.40 @ 2.75
GABRIEL & SCHALL:	
Vorwohler "Lion"	2.65 @ 3.10
HUDSON RIVER CEMENT Co. Rosendale	1. 0
JOHNSON & WILSON:	
Saylor's American Portland	2.15 @ 2.40
LAWRENCE CEMENT Co.:	
Hoffman Rosendale	
LESLEY & TRINKLE, Philadelphia, Pa.:	
"Giant" Portland	2.20 @ 2.40
Improved "Union"	1.25 @ 1.50
Union	1.10 @ 1.20
MARCIAL & Co.:	
J. B. White & Bros. Coarse	4.50 @ 5.00
" Fine	8.00 @ 10.00
" Portland	2.45 @ 2.85
NEW YORK CEMENT Co.:	
Rosendale	1.20
N. Y. & ROSENDALE CEMENT Co.:	
Rosendale, "Bridge" brand	1.10
SINCLAIR & BABSON:	
K. B. & S	2.35 @ 2.60
STANDARD CEMENT Co.	
E. THIELE:	
Dyckerhoff	2.90 @ 3.25
UNITED STATES CEMENT Co.:	
Windsor	1.00 @ 1.10
Standard	1.15
Cable's Portland	2.15 @ 2.40
UNION AKRON CEMENT Co.:	
Akron "Star" brand.	

ASPHALT.

Prices range per ton	$15.00 @ 20.00
According to quantity or brand, and whether taken from vessel or store.	

LIME.

Rockland, common per bbl	1.00
" finishing	1.20
State, common	.90
" finishing	1.10
Kingston, ground	95 @ 1.00
Add 25c. to above figures for yard rates.	

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95 @ 1.00
" " No. 2 "	0.75 @ 0.85
" " light drab "	0.80 @ 0.95
Berlin " in rough "	0.75 @ 1.00
Berea " "	
Brown stone, Portland, Ct. "	1.00 @ 1.35
" Belleville, N. J. "	1.00 @ 1.35
Granite, rough	0.45 @ 1.25
Common building stone per load	2.00 @ 3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40 @ 3.00

SLATE.

Purple roofing per square	6.00 @ 7.00
Green "	6.00 @ 7.00
Red "	15.00
Black Penna. (at New York) "	4.50 @ 5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00 @ 20.00
" Choice "	65.00 @ 70.00
Tally plank, 1¼ in. 10 in. dres'd, each.	.44 @ .50
Tally boards, dressed com. "	.28 @ .30
SPRUCE, Boards dressed "	.25 @ .28
Plank, 1¼ in "	.28 @ .30
" 2 in. "	.38 @ .40
" 2 in. dressed "	.43 @ .45
Timber per M.	20.00 @ 22.00
HEMLOCK, Boards each.	.18 @ .20
Joist, 2½ × 4 to 4 × 6 in	.16 @ .44
OAK per M.	55.00 @ 65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00 @ 40.00
YELLOW PINE, Girders "	25.00 @ 30.00
Dressed flooring "	28.00 @ 35.00
SHINGLES, Extra shaved pine, 16in. "	
" sawed 18 in. "	5.75 @ 6.00
LATH, Cargo rate "	2.25 @ 2.30

PAINT.

Lead, white, American dry per lb	.04¾ @ .06
" " in oil pure "	.06½
English, B. B. in oil "	.06½ @ .07¾
Red, American "	.05½ @ .05½
Litharge "	.05 @ 05½
Venetian red, American "	.01 @ .01¾
Indian red "	.05 @ .10
Vermillion, American lead "	.10½ @ .11½
Paris green "	.15 @ .20
Umber, Amer. raw and powdered per lb.	.01¾ @ .01¾
Drop black, Amer. "	.07 @ .13
" " Eng. "	.11 @ .13
Chrome green "	.05 @ 20
Oxide zinc, American "	.03¾ @ .04
" French "	.06 @ .08

Trade Notes.

NORTHAMPTON Furnace (anthracite), in the Lehigh Valley, Pa., will blow in soon.

IT is said that parties have been examining the Rodman Furnace property, at Roaring Springs, Pa., with a view of putting the furnaces in operation.

THE Ashland, Md., Furnace (anthracite), now in blast, is rented by the Pennsylvania Steel Co., at Steelton, Pa., and is turning out Bessemer iron.

THE Shickle, Harrison & Howard Iron Company report operations a little slack now, but regard the outlook for iron pipe sales for the new year as favorable.

THE nail works of the E. & G. Brooke Iron Company, at Birdsboro, Pa., have shut down, owing to a 10 per cent. reduction which went into effect to-day. Four hundred men are idle.

THE Western Nail Company's new Clapp-Griffith steel plant, at Belleville, Ill., is completed, and will be in operation shortly.

THE puddle and rail mill of the Allentown, Pa., rolling mills has been started up, after an idleness of five years.

THERE will be no suspension of work at the Edgar Thomson Steel Works at Braddock, Pa., enough men having accepted the ten per cent. advance offered by the firm to continue the mill in operation.

THE rod mill of the Cambria Company at Johnstown, Pa., has been put in operation after the suspension.

THE Lochiel Iron and Steel Works, of Harrisburg, Pa., have been chartered at the State Department. The capital stock is $30,000. The company propose to manufacture steel, skelp iron, railroad iron, railroad supplies and merchant iron.

ARRANGEMENTS have been made at Pittsburg, Pa., for the consolidation of Carnegie's Homestead Steel Mill, the Lucy furnaces and the large iron and steel mill of Wilson, Walker & Co. The new concern will have a capital of $3,000,000.

PITTSBURG, December 30.—The iron and steel trade of this city has never been better than at present, and comparison with previous years will show that since the great increase in business which commenced in June last, there has been more iron and steel made in Pittsburg than in any six months in the history of the trade.

THE Architectural Iron Works, St. Louis, Mo., are busy, the mild weather having revived building operations, more particularly in the South. For Texas alone they have taken some half-a-dozen good-sized contracts, and with that and city work a considerable part of their capacity is employed.

THE *Iron Age* says that the report that the Coshocton, O., Iron and Steel Works have been closed indefinitely on account of not being able to compete at the prevailing prices is incorrect. The works are running full time.

THE firm of Stevens & Fenton, of Birmingham, Ala. has been dissolved, Mr. Fenton retiring. A company has been organized with E. G. Stevens as president, which will be known as the Birmingham Fire Brick Works. The paid in capital is said to be $50,000.

A LARGE amount of extra heavy bridge iron has just been completed at Wilson, Walker & Co.'s Union Iron Mills, Pittsburg, Pa., for a bridge which is to span the Mississippi river at St. Paul. The amount of iron and steel required in its construction will be 3,000 tons.

THE total amount of Anthracite mined in 1885, was about 31,500,000 tons, an increase approaching 1,000,000, compared with 1884. The shipments of Bituminous Coal were 5,783,951tons, or a decrease of about 400,000 tons.

THE Association of the Bolt, Nut and Washers Manufacturers quotes the following revised and advanced discounts, referring at the same time to the market as firm, with some probability of a further advance:

Machine Bolts	dis. 75 & 5 %
Bolt Ends	dis. 75 & 5 %
Square Nuts	8¾ cts. ℔ lb. off
Hexagon Nuts	9¾ cts. ℔ lb. off
Washers	8¾ cts. ℔ lb. off
Lag Screws	dis. 75 & 10 %

In lots of less than 100 lb. of a size ¼ cent ℔ lb. extra is added to the price of Nuts and Washers, as heretofore.

THE Philadelphia *Press* says:

The feeling in the iron trade is as buoyant as ever, however, and every one seems to be encouraged by the prospects for the coming year.

Prices range from $16 to $18 delivered at high tide for standard to choice brands of Gray Forge pig iron and $18 to $20 for No. I foundry.

The steel rail demand is still very active, and mills are all very full of work. Prices are firm at from $34.50 to $35 at the mill, with indications of a further advance toward spring.

THE building record of the year indicates a revival of prosperity, not so much by the total cost of the new buildings projected or under construction as by the fact that so many of these are "first-class dwellings.' Nobody can traverse the streets on the west side of the park without wonder at the number of new houses of this description.

The demand for these seems to show that the supply of very costly apartment houses has become nearly equal to the demand, and the same thing appears to be true of tenement houses. That is to say, the lowest and the highest grade of associated dwellings show a falling off, while the increase is chiefly in costly single dwellings and in flats of moderate cost distinctly above the tenement house.

In any view of the figures, the fact is very impressive that over $40,000,000 of savings are annually invested in bricks and mortar on Manhattan Island.—*N. Y. Times.*

AN ENGLISH VIEW.—A period of 18 months has now elapsed since the panic of May, 1884, and as American railroad managers have been pursuing a policy of extreme caution during this period, and have in consequence been purchasing rails sparingly, they are now under the necessity of giving out orders a little more freely for renewal purposes as well as for the new sidings and branches which every established American railroad company finds it necessary to construct from time to time. In addition to this, capital has again begun to accumulate to the great American centres, and American investors are growing tired of the moderate rates of interest obtainable in New York, Philadelphia and Boston. They are, therefore, more prepared than they were 18 months since to embark in the securities of new western railroad undertakings: and the result is that there has been some tendency to resume constructive operations with more vigor than has been brought to bear upon them since May, 1884. The field offered by the Western States to the American railroad engineer is, no doubt, a vast and tempting one; the only danger is that the construction of new railroads may be hurried on before they are really wanted, and in that case a reaction is sure to follow.—*Herapath's Railway Journal.*

Steel, How Shall We Test It?

Written for ENGINEERING NEWS.

BY F. COLLINGWOOD, C. E.

This subject has been under discussion for a long time, and it would seem that the time has arrived when those who manufacture steel, and those who use it, should come to a substantial agreement as to what tests are necessary. At the outset of its use by engineers for structural purposes, exceedingly rigorous specifications were introduced into all contracts, and yet it is a question whether faulty material did not pass inspection, owing to defective methods of testing. The following article is prepared with the intent of presenting the latest practice in this important matter.

There seems to be substantial agreement among engineers, both at home and abroad, as to the *character* of the tests, with considerable diversity as to the requirements under them.

1st. The rule is now quite general, that every "blow" or "cast" should have its number stamped upon the blooms, and afterward upon each plate, bar or beam, rolled from it.

2nd. Some engineers make tests for ductility (at least one from each blow) from pieces cut from the blooms and drawn down under the hammer to sample bars usually one inch square. In this country, and largely in Europe, the stretch on a length of 8 inches is taken; but 10 inches is recommended by some for convenience in calculating. Others take the samples from the finished plates or bars, selected at random from each blow, or from crop ends of same marked for identification (sometimes from each fifty plates or bars, but this is not good practice).

In plates the samples are taken both in the direction of rolling and across the same.

3rd. Most foreign engineers require the temper test of heating to a cherry red, plunging in water at 82 degrees Fahrenheit and requiring that the strip thus treated shall bend to a U shape with an interior curve of which the radius is one and one-half times the thickness of the piece. (In the case of ship plates the *diameter* of curve must be one-half times the thickness of plate.)

4th. It seems to be conceded that even where the foregoing tests are satisfactory, it is absolutely necessary to have some sort of test of every piece of metal rolled from the same, to determine whether the metal has been damaged in rolling.

5th. There is a nearly unanimous opinion that engineers should not specify the chemical constitution of steel.

Special examples of practice are as follows: The specifications for the Forth Bridge require that a tensile or temper test, or both, be made from *every* beam, plate, or angle. In a recent discussion, however, Mr. Baker, one of the engineers, makes the broad statement, that the angle, to which a piece can be bent before breaking "in the hands of an experienced man, is just as sound a test of ductility as can be obtained after going through all the elaborate preparation, involving half a day's labor of preparing the specimen for direct testing in a machine."

The tests for the steel in the superstructure of the East River Bridge were based on this idea. Tensile tests were always made on samples cut from the blooms. These determined the quality of the metal as to absolute strength. Then crop ends were saved from every piece rolled from the blooms, and marked for identification. These were each submitted to a rough test by bending with a hammer or sledge, and if unsatisfactory, then tensile tests were made of the corresponding piece from which they were cut; but if satisfactory, the pieces were accepted.

The French Admiralty require not only the tensile and temper tests, but also certain tests on plates and beams selected from each delivery, calculated to show whether the metal will bear flanging and working in the forge.

The Russian ship-yard tests include tensile and temper tests, and also a bending test, after the metal has been cooled to zero Fahr.

As to the *strength* of material the Russian requirements for boiler plates are 58,000 to 67,000 lbs. per square inch strength at rupture, with 20 per cent. stretch on 8 inches, and for ship plates 58,000 to 69,500 lbs., with 17 per cent. The French Admiralty recognize the fact that rolling increases the tenacity, and prescribe for thin plates, up to ¼ inch in thickness, a "minimum average" strength of 67,000 lbs. per square inch, with a stretch of 10 to 14 per cent. on 8 inches; and for thick plates ¾ inch and over, 63,000 lbs. with 20 per cent. stretch. For intermediate thicknesses intermediate values are adopted.

Similarly for angles and T's, samples from the web must bear 68,000 lbs. per square inch, and stretch 18 to 20 per cent.; and for I and bulb beams 65,500 lbs., and 16 to 18 per cent.

The Lloyds, England, requirements were that steel in ship plates shall bear 60,500 to 69,500 lbs., and stretch 16 per cent. on 8 inches. This has been lately increased to 1 ton. Beams and angles must bear 60,500 to 74,000 lbs., and stretch 16 per cent. Boiler plates 58,000 to 67,000 lbs. and stretch 20 per cent.

The requirements for the Forth Bridge are 67,000 to 74,000 lbs., with 20 per cent. stretch on 8 inches for steel used in tension; and 67,000 to 83,000 lbs. and 17 per cent. stretch for that used in compression; all tests being made from the finished product.

The East River Bridge steel (from a summation of all the tests made) averaged 80,000 lbs., and about 20 per cent. stretch, the rivet steel being 75,000 lbs. and 25 per cent. stretch.

One detail of all tensile tests is strongly insisted upon by many engineers, and by some even to the exclusion of the consideration of the stretch, viz.: the reduction of area at the point of fracture. It is held that the metal which *contracts* most, will be the best able to resist shocks.

Minor details worthy of mention are as follows: A recent French specification makes the important requirement that the stretch shall progress regularly as the weight is applied, and "*without sudden jumps.*"

The older specifications allowed little or no smoothing of the edges of test pieces, whereas Mr. Baker, M. I. C. E., has shown that unless *planed*, the test is uncertain and liable to be misleading, more especially when the steel tested is high in grade.

It is now well established that test pieces to give comparable tests as to stretch must have constant ratios of diameter or thickness to length, and of thickness to *breadth*, in case of flat strips.

It is also certain that the *width* of pieces to be tested by bending should be stated; since a narrow piece will bend with less difficulty than a wide one.

Specifications also should be explicit, as to whether tests are on strips cut from bars, or on whole bars, and a proper difference made between the two,—also whether annealed or unannealed, or whether worked in any way after cutting.

Some engineers introduce the element of time, applying first a minimum load for five minutes, and then increasing it by definite amounts at intervals of half a minute.

As to falling weight, tests for axles, rails, etc., the elements to be secured in order that tests may be comparable, are: 1st, a common distance between supports; 2nd, a common weight of trip; 3rd, uniformity in the successive distances fallen through by the trip; 4th, a massive bed on which supports rest.

There remains one branch of the subject not yet touched upon, viz: the use of steel in eye-bars. It is claimed that we are not yet authorized to adopt it for such forms, on account of the uncertainty as to its condition after the formation of the eye. The question is whether any tests can be devised to assure engineers on this point, and whether there is any more risk of unsoundness, than there is in the use of iron.

European bridges are almost exclusively of the riveted forms, and therefore furnish no experience on this point.

Armor Material in Europe.*

Official Report to the U. S. War Department.

BY WM. H. BIXBY, CAPT. OF ENGINEERS U.S.A.

Manufacture.

Wrought-iron steel-faced and steel armor.—The manufacture of wrought-iron, steel-faced and steel armor has been well summarized, and its tests given by Generals Barnard, Wright, and Col. Michie [1], Col. Inglis [2], and Lieut. Very [3]; that of steel-faced armor by Col. Inglis [4], Very [5], and Gen. Abbot [6]; and that of steel armor by Gen. Abbot [7].

All the steel-faced iron of to-day is furnished either by John Brown & Co., or by Cammell & Co., of Sheffield. Both manufacturers agree substantially in the conditions of manufacture and in their prices.

The all-steel plates, so far made, are manufactured by M. Schneider of Creusot, France. Their dimensions are about the same as those of steel-faced plates. Their cost varies from $300 to $600 per ton.

The plates should not be over 11 feet in width, 15 feet in length, 19 inches in thickness, 50 tons in weight when rolled (30 tons when trimmed and finished); if either of these conditions is exceeded, the expense is enormously increased. The cost of such plates varies all the way from $300 per ton for thin and small plates, up to $500 per ton for thick or heavy plates.

Chilled-cast-iron armor.—Since 1870, the most remarkable development in the way of armor is that made by chilled-cast-iron. The first really serious trials of this new armor material were made in 1869; in 1874 it was officially adopted by Germany in the place of all other armor material for inland and coast forts; from 1875 to 1884, it has been used for the actual construction of 25 cupola forts and 2 casemated batteries, of which 13 were for heavy guns. This is the more remarkable because only one wrought-iron land fort for heavy guns was anywhere constructed during the same period.

Germany, Austria, Belgium, and Holland are now actually using these chilled-iron forts.

The chilled-cast-iron armor, when properly

*Published in ENGINEERING NEWS by permission of the War Department.

[1] See pages 40 to 42, U. S. Engrs. Prof. Paper, No. 21, 1871.

[2] See pages 277-8, Vol. 7, R.E.P.P. for 1883; reprinted in U. S. Ord. Notes, No. 151.

[3] See pp. 560-567, and pp. 582-3, Very, Development of Armor for Naval Use, 1823.

[4] See pages 279,280, Vol. 7, R.E.P.P., for 1883; and U. S. Ord. Notes, No. 151.

[5] See pages 572, 575, Very, Development of Armor, 1883.

[6] See pp. 5 and 6, Abbot, Hasty Notes—Military Engineering in Europe, Engineer Department, Washington, 1883.

[7] See page 7, of the work last quoted.

made and used, possesses many advantages, as follows:

It can be easily and quickly manufactured; every large iron foundry in the country with 3 cupola-furnaces and a 150-ton crane, under the guidance of a trained foreman, could on an emergency turn out a roughly made but serviceable chilled-iron-armor for heavy guns all ready to be mounted in place at the rate of one turret per month. More careful work would of course take more time. The manufacture of other kinds of iron armor cannot be carried on without an expensive plant, varied and costly machinery, much time, and the services of many men.

It can be quickly mounted in place:—As it does not make use of bolts, and as all its joints are made by the use of melted zinc run into place after the separate parts of the turret or casemate are in their proper positions, the time of mounting of a chilled iron fort depends only upon the time necessary to lift and move the separate plates. The mounting of other iron armor requires a much longer time, owing to the presence of many joints, bolts, and bolt holes, which must be made and fitted to each other with extreme care.

It can receive any shape and any amount of curvature at hardly any more extra expense than that due to preparing the corresponding brick or wooden moulds. The slightest curvature given to other iron armor, enormously increases its cost during rolling, bending, trimming and mounting. The facility with which the outer surface of chilled-iron armor can be shaped to any form, allows a domed surface to be used in place of a cylindrical surface for the sides and top of the turrets, thus reducing by about 20 per cent. the apparent size of the turret, and by nearly 50 per cent. the surface of exposure to shots striking at an angle of incidence of from 90 to 45 degrees.

The cheapness of the material allows the use of a very thick and heavy mass of metal. This extra amount of weight and mass is of great advantage against battering shots, and especially against single shots from heavy guns, whose single blow may strike with 40,000 foot-tons of energy.

The great elasticity of the metal transmits the effect of a shot directly to all parts of the plate struck, following the elements of a cone whose vertex is at the point struck and whose base is on the rear surface of the armor plate. On this account, the surface of strain increases at least with the square of the thickness of the metal; and if the plate is very thick and the metal very elastic, the resistance increases nearly with the mass of the plate. On the other hand, in wrought-iron, and all other soft metals, the effects of the shot follow the elements of a cylinder; and the resistance can increase only with the first power of the plate's thickness.

The exterior hardness of Gruson chilled-iron (generally acknowledged to be greater than that of steel) is so great as to shiver all projectiles (even hardened steel), that have so far been fired against it; this hardness moreover would prevent any obliquely-hitting shot from "biting" and turning inward, even were it to remain unbroken. As no shot can ever get any further than the mere surface of the metal, sharp pointed shot and dynamite projectiles are no more to be feared than ordinary shot.

The absence of bolts prevents any danger from flying bolt heads during action. Moreover, as shown by all the tests at Tegel and Buckau, no flying splinters are sent off from the interior of chilled-iron armor-plates until the armor has been very badly broken.

The *disadvantages* of the chilled-iron armor are its weight, where weight is not desired; the difficulty of calculating the proper thickness to resist given projectiles; and finally the fact that chilled-iron armor plate will always be cracked when struck by a shot that is fairly a match for it; and that the armor will be soon knocked to pieces if the same plate be struck several times by such shots.

Chilled-cast-iron armor must be properly made in order to be of use. The careful manufacture of chilled-iron plates for fortification purposes requires a very large and very expensive plant of machinery (expensive as regards ordinary iron work, but cheap in comparison with that needed for the construction of thick wrought-iron and steel or steel-faced plates); some of the iron chills of ordinary cast-iron are of (150) tons weight, and of a single piece of iron; some of the chilled-iron plates are of (50) tons weight each; these must be handled by special cranes which are of course quite expensive. The chilled-iron is moreover extremely hard, and its proper working requires special machinery and tools. The casting of chilled-iron, so as to give the best results, requires special experience, which can only be obtained by long practice.

No iron foundry could afford to put up a plant for such work, unless its ordinary business was the manufacture of chilled-iron, and unless it was sure of receiving orders for at least a dozen cupola-forts; or unless it were guaranteed an excessively high price for its merchandise. The claims of the Gruson factory are that it has made a speciality of chilled-iron for the last twenty (20) years, has done an immense amount of such work, has had more experience in the business than any one else, and has filled or is filling orders from enough countries to enable it to work at a reasonable price. At any rate, all foreign publications and military writers have always spoken in the highest terms of the quality of the Gruson chilled-iron, especially after examining the surfaces of fracture of plates broken during the various test-trials at Tegel and Buckau-Magdeburg. Some of these fractures have said to have shown a uniformly graded chill extending inward from the surface of the metal to a depth of 6 inches. Other manufacturers (especially France) have attempted the manufacture of chilled-iron, but not always with good results.

The manufacture of chilled-iron everywhere is more or less a trade-secret. The composition of the iron and of the added "spiegel," the temperature of the molten metal and of the chill at the moment of casting, and other small but essential details; all those are regarded as the private property of the manufacturer. The condition of chilled-iron manufacture in England is well shown by the following article extracted from the London *Engineer*, page 473, of December 24th, 1880, and page 1, of January 7th, 1881.

"When solids cool from fusion, their crystals arrange and group themselves with their principal axes in lines perpendicular to the cooling surfaces; when the cooling is rapidly effected, the metal also becomes entirely hardened. The reasons for these facts are not yet well known.

In plain castings, the depth of chill increases with the thickness of the chilling mould. In irregular shaped castings, the same rule holds good up to a certain limit; beyond this limit, any addition to the thickness of the mould causes an irregular cooling of the irregular shaped casting, and leads to unfavorable results.

It is impossible to predict beforehand whether a certain quality of iron, or iron showing certain results on analysis, will or will not provide castings with a certain desired depth of chill.

Generally speaking, the best iron for chillling is an iron in which a large part of its carbon is already in combined state, as the carbon in the chilled portion of castings is almost wholly in that state.

For most purposes, such a mixture of iron as will produce a so-called gray mottled iron, will be well suited for chilled castings. This iron will combine the properties of white iron, white has high cohesion accompanied with great brittleness, with the dark gray graphite iron of opposite properties. The resulting mixture will possess both high tenacity and toughness.

The chill models need to be of course quite thick to stand the effects of the extreme heating to which they are to be so suddenly subjected. The runner is made to enter tangentially to the inner circumference of the chill mould so as to produce rotation in the metal, by which scoriæ and gases are assisted to rise to the top surface and thus removed from the surface to be eventually chilled; this rotation must not be made too rapid.

The chill mould must be of a good, strong, mottled iron, surfaced and free from holes. Its inner surface, if bored out, should be sound and smooth; if cast, should be hammered smooth. The chilling surface should be coated with a thin wash of fine black lead and pure clay; and the whole mould heated to the usual temperature of 160 degrees to 200 degrees before receiving the melted iron.

For small castings, where 6-4 inch depth of chill is desired, a good result may be obtained from

Hematite, No. 5	5 parts;
Lilleshall C. B	5 "
Cleator white	4 "
Total	14

more certain to produce the desired chill if first melted, then run into pigs, and then remelted.

A mixture which gives from 2 inches to 3 inches depth of chill, consists of:

Cleator white	4 parts:
Brymbo	4 "
Lilleshall, C.B	8 "
Hematite No. 3	6 "
Pontypool No. 3	2 "
Total	24 parts:
Hematite mottled	1 part
Hematite, No. 5 strong	1 "
Blaenavon or Pontypool, C.B	1 "
Total	3 parts.

For chilled castings exposed to impact shock, such as chilled shot and shell, it is very necessary to secure a mixture which will give a deep chill without a sharply defined line, the chill should gradually fade off or merge into the gray or mottled character. When a shot with a sharply defined chill has been fired against an armor plate, the chilled part has cracked and fallen off, so that hematite and Blaenavon irons are not found suitable for this purpose. Chilled shot and shells are of course only made in a few places, so that we have not been able to ascertain whether a mixture of other irons with the following will effect the required evanescent chill. Cwmbran iron has been found necessary for the purpose. This is very rich in manganese, and the whole of the carbon is in a combined form, as the following analysis will show:

	Cwmbran pig iron No. 1.	White.
Carbon graphite	3.14	——
Combined carbon	.55	3.50
Silicon	2.22	1.15
Sulphur	.02	.48
Phosphorus	.16	.17
Manganese	.88	.88

These shells are cast in heavy chills; the following mixture has been found to effect the required chill, while retaining the necessary strength in the unchilled portions:

Cwmbran	5 parts
Scrap from casting of shot and shell	2 1-2 "
Old cast iron guns	2 1-2 "

For the surface of the chill for hammer blocks, a correspondent recommends the use of oil and plumbago, while he also commends the use of plumbago No. 1450, Battersea, for the chills and for finishing the mould surface for small castings.

In making chilled castings on chill moulds of closed forms it is necessary to observe that the casting be not of such form that it so overlaps the outer parts of the mould as to be strained by its own contraction and the expansion of the chill, as this is likely to break the casting.

It is not sufficient that the founder should find a good mixture for producing castings with a required depth of chill, as so many conditions and circumstances operate to affect that depth. It is very necessary to test the mixture frequently by casting test pieces, and examining not only the chill but the character and quality of that part which is not really chilled. For many purposes it is desirable that a strongly marked chill should be obtained, having the inner part of the casting as soft or as tough as possible. Many mixtures may be easily made which will give a sufficient or a very deep chill by increasing the quantity of white iron used, but this may be at the expense of the strength of the casting, and hence such changes in the mixture must be made as will secure a chill of the required depth and still leave that part of the casting which it is not desired should be chilled in a normal state, so that the

strength of the casting is not sacrificed. Most irons will on the other hand take a surface chill, but this is rarely of any use, and as all irons are susceptible of variation in character both in the blast furnace and in the cupola, it is highly desirable that great care should be taken in making frequent tests of the iron as it is used from the cupola in making the castings. When any considerable quantity of scrap from various sources is used this is especially necessary, as the castings which have formed scrap will probably have been made from very numerous brands of pig.

Great care is always necessary to secure the proper mixture of iron. Many firms do not pay the necessary attention to the many points involved in the success of such work. In a recent action, brought by an iron founder against certain contractors to whom he had supplied chilled wheels, the evidence showed that the wheels were certainly not chilled wheels. Several witnesses were called who have undoubtedly had considerable experience in chilled castings. Among these was Mr. R. C. Rapier, C. E., of Ransomes & Rapier, now large makers of chilled castings—amongst others, the chilled points and crossings originally made under Mr. G. A. Biddell's patent, and in which a deep and uniform chill must be combined with strength in the casting as a whole. These gentlemen gave evidence of the unsuitable character of the mixture actually used. When asked what iron should have been used with that mixture, Mr. Rapier was obliged to say that he preferred not to answer the question, as only *years of experience and constant attention* would enable anyone to learn that, and consequent y by those who at considerable expense had gained *the necessary information, it was held a trade-secret.*"

Chilled iron has been officially adopted as armor material by Germany; and as it is being used for fort construction all over Europe; it is important that American engineers should know why. The writer has therefore appended a complete history of all the important trials of chilled-cast-iron from 1869 to 1881, including a careful translation of the German official reports of the test-trials which decided Germany in favor of the chilled-iron.

Mr. Herman Gruson, of Buckau-Magdeburg, Germany, has ever since 1865 been manufacturing chilled-cast-iron for war purposes. From 1870 to 1884, he actually constructed twenty-two chilled-cast-iron cupola-turrets, and he was then at work upon six more, as follows:

Executed works:

3 cupolas, each for two guns of 15. 6-c.m. (5.9-inch) caliber, Metz, 1875-6.

1 cupola, for two guns of 15-c.m. (5. 9-inch) caliber Cologne, 1877.

2 cupolas, each for two guns of 15-c.m. (5.9-inch) caliber, Ingolstadt, 1879 80.

2 cupolas, each for two guns of 15-c.m. (5.9-inch) caliber, Weser mouth, 1877.

3 cupolas, each for two guns of 28-c.m. (11.0 inch) caliber, Brinkamahoff II, 1875.

5 cupolas, each for one gun of 28-c.m. (11.0-inch) caliber, Langlutzensand II, 1876-7.

2 cupolas, each for two guns of 12-c.m. (4.7-inch) caliber, for Malborghetta Austria, 1881-2.

1 cupola, for two guns of 12-c.m. (4 7-inch) caliber, for Trient, Austria, 1882.

3 cupolas, each for two guns of 28-c.m. (11.0-inch) caliber, for Pola, Austria, 1881-3.

In execution:

2 cupolas, each for two guns of 30.5-c.m. (12.0-inch) caliber, for Ft. Harssens, Helder, Holland, 1882 84.

2 cupolas, each for two guns of 24-c.m. (9.4-inch) caliber, for Maasmunding (Rotterdam Canal), Holland, 1883 4.

1 cupola, for two guns of 15-c.m. (5.9 inch) caliber, for Maasmunding (Rotterdam Canal) Holland, 1883-4.

1 cupola, for two guns of 15-c.m. (5.9-inch) caliber, for Ymuiden (No. Sea Canal), Holland, 1884-5.

The largest of these turrets are those at Ft. Harssens; they mount two 12-inch 37-ton B.-L. guns, with a moving load of 713 tons. Mr. Gruson supplies these turrets with his own carriages, and hydraulic apparatus.

The Gruson cupolas for inland defence are as yet generally constructed only strong enough to resist a steady fire from 6-inch guns. The cupolas for sea coast defence are as yet generally constructed strong enough to resist only an unsteady fire from 100-ton guns.

Besides these 28 cupola turrets, he had also in 1884 constructed two chilled-cast-iron casemate-batteries; and he was then at work upon two more, as follows:

Executed works:

1 battery, for nine guns of 21-c.m. (8.3-inch) caliber, for Langlutzensand I, 1874-5 (see Part IV, Germany).

1 battery for six guns of 24-c.m. (9.4-inch) caliber, for St. Marie, Antwerp, 1877 (see Part IV, Belgium).

In execution:

1 battery, for four guns of 12-c.m. (4.7-inch) caliber, for Malborghetta, Austria, 1881 (see Part IV, Austria).

1 battery, for five guns of 24-c.m. (9.4-inch) caliber, for Ymuiden, Holland, 1884-5 (see Part IV, Holland). He has still others in project for Spain, Switzerland and Italy.

(TO BE CONTINUED.)

ENGLISH TRAMWAYS.

Translation of the Report of M. Barabant, Chief Engineer of Public Ways, Paris, 1884.

BY CAPT. F. V. GREENE, U. S. ENG'S.

TRAMWAYS.

We are less interested in the tramways themselves than in the effect which they produce on the street pavements; we shall therefore not go into the question of concession and management, nor even into the very different systems of rails in use in England. We shall examine more especially the results produced on the various kinds of pavements (macadam, wood, stone, asphalt) by the presence of rails, both as regards first cost and also maintenance.

In London the tramways have not developed as much as might have been expected. As we have already said the tramways do not penetrate very far towards the center of the city, and do not even enter "The City" (London) at all. The administration of "The City" absolutely forbids them on account of the trouble which they give to ordinary vehicles, and the serious inconvenience which they offer to keeping the streets in proper order.

It is true that they have in London the Metropolitan (Underground) Railroad, which serves very well for the center of the town, and unites it to the extremities and the suburbs in a most satisfactory manner. In the other English cities that we saw, the tramways on the contrary are greatly developed and penetrate to the very heart of the cities.

In England, as in France, they began with the road called American, formed of rails of iron or steel, very light, usually badly jointed, laid on sleepers of very little strength and placed simply on sand as a foundation.

Wherever the travel has been heavy, the result has been, as in Paris, a complete wreck of the pavements, whose proper maintenance is radically impossible with this system of rails, at least on streets of heavy traffic.

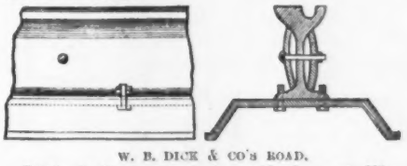
Ordinarily the English Tramway Companies have to pay the entire expense of the paving within the limits of their roads, *i. e.* between two lines about 18 inches beyond the exterior rails; the gauge is ordinarily 4 feet 8½ inches, and the space between the tracks 3 or 4 feet.

At the beginning there were in England, as in France, a great many false hopes about the future of tramways; the original companies failed in many places; those who followed them are succeeding better because the advantages and disadvantages of tramways are better understood, and because now more solid roads are usually built.

At Liverpool, the city government took the bull by the horns; the original companies managed and kept up their roads badly; the city bought them out for 750,000 francs ($150,000) completely rebuilt the roads in the manner explained later on, then ceded back the lines, once they were well established, to companies which pay the city *First*, 10 per cent. of the expenses of rebuilding, and *Second*, a tax equal to 7 per cent. on the expense of purchase. The roads being solidly built and easy to keep up, the new companies are very prosperous.

There is far from being a perfect accord of opinion in England as to the best type of tramways. A large number of different systems have been tried; each city, each corporation has its own type of tramways. We shall indicate as briefly as possible what we have seen, and those which seem to us the best; we shall endeavor to point out their advantages and disadvantages, and to pick out from this varied mass certain general principles, on which engineers are pretty well agreed.

We refer to the work of Mr. Clark, translated into French by Chief Engineer Chemin, (Dunod, 1880), for the systems which appeared prior to its publication, and we shall show hereafter the systems which have appeared more recently.

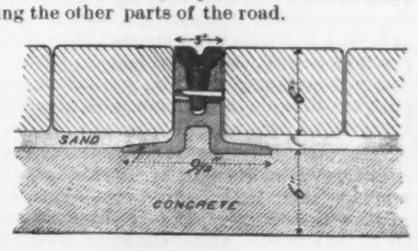


W. B. DICK & CO'S ROAD.

Dick & Co.'s track is entirely metallic; it consists of a steel rail about 6 inches high, 3½ inches wide at top and bottom, and 24 feet long. This rail, which can be very securely jointed, is fastened down by keyed bolts to a metallic stringer, having nearly the shape of a Zores iron very much flattened, and about 14 inches wide at the base. The rail weighs from 50 to 60 pounds per yard, and the sleeper 40 pounds. The running yard of single track therefore requires from 100 to 120 pounds of steel for the rails, and 80 pounds for the sleepers. This system is therefore quite expensive, but it is very solid and well suited to heavy loads, steam tramways, etc. The defect is in the method of fastening the rail to the sleeper; the keys get loose under the action of the wheels, and to tighten them up, some paving blocks must be taken up. In Paris, where the blocks are more than 6 inches deep, it would be necessary to raise the height of the rail to 7½ inches, which would increase the price.

We saw building in the suburbs of London, between Hammersmith and Richmond, a system devised by Mr. Kinkaid, a very competent engineer in matters relating to tramways, charged with directing or advising more than one hundred tramway companies, whose opinions have great weight on these questions, and who gave us information with great kindness.

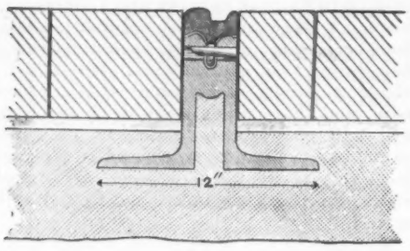
Mr. Kinkaid proposed to make a road in which that part of the rail which alone is worn out could be easily replaced without disturbing the other parts of the road.



KINKAID TRAMWAY.

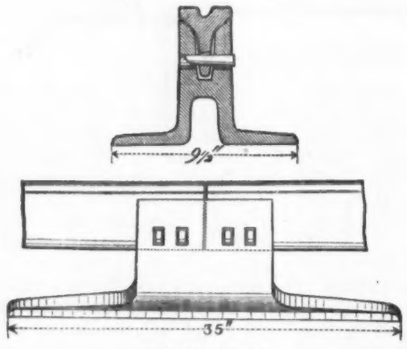
The rail is of steel, three inches wide on top, and the groove in the middle of the upper face; the total height of the rail, properly speaking, is only 4 inches, and under the head runs a vertical web or flange which enters the space formed by the two cheeks of the chair, and is pierced at intervals with holes through which pass horizontal keys. The chair is of

cast-iron, about 6 inches in height, having on top a longitudinal slot in which the web of the rail enters. The chair has a very broad base (9½ inches) and forms a flange of great length



BARKER SYSTEM (MANCHESTER.)

(35 inches). The rail, which is 24 feet long, rests on ordinary chairs every 3 feet. At each joint a large joint-chair is pierced with 4 holes corresponding to the 4 iron keys. There are 7 ordinary chairs and 1 joint-chair for every rail. The ends of the flange of adjoining chairs are only 1½ inches apart.



KINKAID SYSTEM.

This road is built on concrete and is very firm. The steel rail weighs 50 pounds to the yard; the ordinary chairs weighs 50 pounds, and the joint-chairs about 60 pounds.

Mr. Kinkaid estimates the cost of this road at $20,000 per mile of single track, including paving and concrete, of which we shall speak later. We shall see hereafter that the tramways which it is proposed to construct in Paris will not cost much less. This system which comes to $40,000 per mile of double track offers great guarantees of solidity and easy maintenance. The weak point is perhaps the key used to fasten the rail to the chair; it would be hard to prevent it from being crushed or at least getting loose, which would require from time to time the lifting of a paving block in order to key it up or replace it. This system differs from the first Kinkaid System, which is described in Mr. Clark's book, and is in use in Bristol, in the fact the flanges of the chairs are broader and, especially, longer. The tendency is evidently towards continuous support, *i. e.* towards the stringer rather than the cross tie.

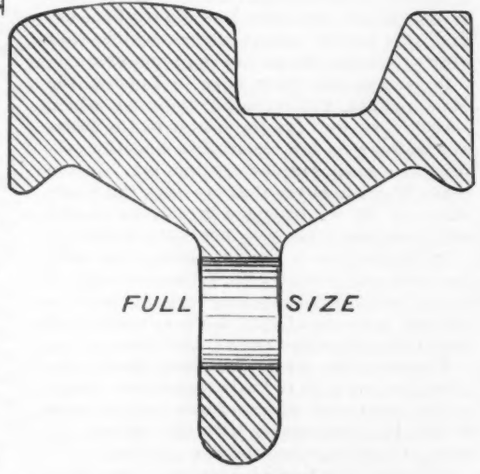
The Barker System, employed at Manchester, and described in Mr. Clark's book, resembles this latter type somewhat, but realizes the desideratum of continuous support. The rail has under the head a vertical rib entering the slot of a continuous cast-iron stringer resting on concrete, by means of a continuous flange 1 foot wide, above which there is an open space 8 inches high. At Manchester, on account of local considerations and a firm soil the concrete was dispensed with. The paving blocks, 6 inches high, are simply placed on a bed of thin hydraulic mortar $\frac{5}{16}$ inches to 1½ inches thick, worked under the stringer in such a way as to fill the hollow of the lower part. The joints of the blocks are filled with gravel and a boiling mixture of gas, tar and creosote, according to a method which we shall also find at Liverpool.

The two upper portions of the stringer, on the right and left of the slot, receive the lower faces of the head of the rail, which is well supported and is fastened to the stringer by a key. The stringers of the same track break joints; they are formed of pieces, each one yard long placed end to end; they weigh 136 pounds per year. The rail weighs 40 pounds, so that for each mile of single track it requires 65 tons of Bessemer steel and 440 tons of cast-iron; the ordinary length of the rail is 24 feet. The cost is $23,000 per mile of double track, exclusive of paving and concrete, which would be necessary on an ordinary soil, and in which the flange of the stringer would be imbedded as we have indicated on our sketch.

Concrete 1760 × 6 = 10,560 sq. yds., at 75 cents	$7,920
Paving " " " " 80 "	8,448
	$16,368
	23,000
Total per mile of double track	$39,368

It is noticed that the blocks touching the rail on the right and left are well supported against lateral yielding; nor can they sink, for they rest on the flange of the stringer. These are excellent conditions for keeping the pavement in order.

The rail is 3 inches wide on top and 3 inches high; the groove is $\frac{11}{16}$ inches deep, $\frac{3}{4}$ inches wide at the bottom, and 1$\frac{1}{8}$ inches at the top; the side of this groove is vertical on the side next the wheel, which is 1½ inches wide, and inclined on the side of the smaller edge, which is $\frac{3}{4}$ inches wide.



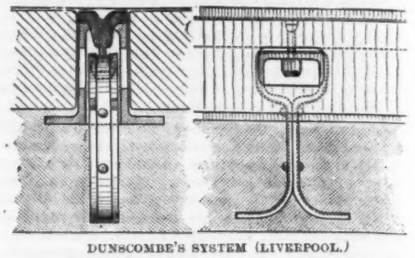
BARKER RAIL.

All these shapes appear to us excellent, except the thickness of the smaller edge, which seems to us insufficient, and which ought to be increased to $\frac{5}{8}$ inches or $\frac{3}{4}$ inches in order to avoid rapid wear, and consequently disagreeable enlargement of the groove.

In brief, the Barker System appears to us to combine theoretically nearly all the good qualities, except the inconvenience of the smallness of the smalled edge, and the method of fastening by keys. But we have not seen the application of this system, not having the time to go to Manchester.

We have already stated that the City of Liverpool has entirely and radically relaid its own tramways. This reconstruction begun in 1877, by Mr. Deacon, then City Engineer, and has been continued under the direction of Mr. Dunscombe, his successor, who showed us the details of a very interesting and well managed factory for the complete construction of a street with two lines of tramways.

The system of Mr. Deacon is described in Clark's book; that of Mr. Dunscombe appears to us to be an improvement.



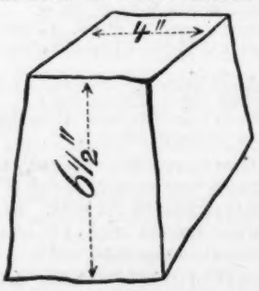
DUNSCOMBE'S SYSTEM (LIVERPOOL.)

The road adopted in Liverpool is entirely metallic. It is composed of a continuous stringer of cast-iron with flanges, with a vertical slot in which enters the web of a steel rail, whose sides rest on the head of the stringer, very much as in the Barker System, but with a different mode of attachment. The Barker & Kinkaid rails for example, are simply keyed to the stringer by small horizontal pins or keys of cast-iron or steel; these keys work loose or get broken; to keep them up or replace them, it is necessary to take up at least one paving block. Mr. Dunscombe obviates this defect by fastening his rail with a bronze screw bolt and an anchor built in the solid concrete. The groove of the rail is in the middle of the rail and the flange of the wheel is also in the middle of the felloe (tire). The head of the bronze bolt is level with the bottom of the groove. An opening left in the vertical sides of the stringer at intervals of 3 feet, allows the nut to be screwed on, which is at the lower end of the bolt and which supports the anchor.

When the concrete in which the anchor is placed has set, the bolt is tightly screwed up after taking care to bring the lower end of this bolt into the concrete, which in hardening prevents the nut from turning and allows the bolt to be screwed up with a screwdriver on the head of the bolt at the bottom of the groove in the rail.

We saw a large factory built for the construction of a double track tramway, and at the same time for paving one of the main streets in Liverpool. As has been said, the factory was well organized. The work was done by contract, under the immediate direction of the City Engineer, who had previously made all the tests of the metallic portions of the road.

First, a foundation of pebbles, with a thin mortar of Portland cement, was placed on the natural soil. On this foundation were placed at intervals of 3 feet small blocks of concrete, having the exact height of the mass of concrete on which the paving blocks were to be laid and in which the anchors were to be imbedded. On these blocks were placed the stringers, then the rails, leaving the anchors hanging. The concrete was then made in the proportions of 1 part Portland cement, 6 parts sand, and 8 parts broken pebbles. This concrete which as is seen was quite thin,



was carefully rammed and smoothed and then perfectly graded; the fine concrete was then placed around the head of the nut and finally, after some time, the bolt was screwed up.

The advantages of this system are as follows:

First. The stringer being continuous and

the rail tightly fastened to this stringer, the road is quite rigid; it is at the same time easy for vehicles and passengers, because it avoids the shocks due on ordinary roads, to the imperfections of the splicing and cross-tying of the rails. At the ends of the rails, which are 24 feet long, the bolts are closer together and more numerous.

Second. The rails can be screwed up with an ordinary turn-screw (large screwdriver), or they can be taken up and relaid without touching a single paving block.

Third. The outer sides of the stringer are vertical and full, and form an excellent support for the lateral face of the paving block next to the rail; the block cannot turn; it cannot sink, resting as it does on the flange of the stringer.

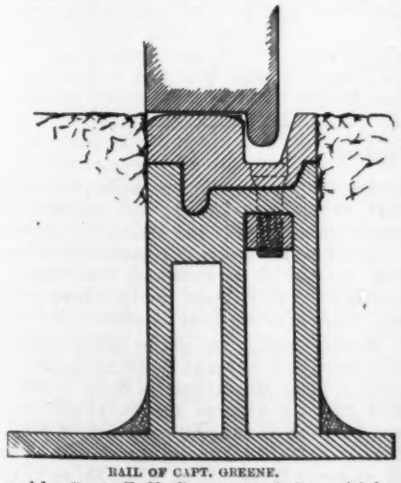
Fourth. The road forming one solid piece with the massive foundation does not get out of order and remains perfectly true in grade and position.

The paving is composed of blocks of syenite 3½ inches × 6½ inches × 6½ inches. The blocks next to the rail are cut with the greatest care, so that the longitudinal and transverse joints along the rail are almost nothing.

The single track costs $31,000 per mile. It is therefore expensive. Moreover, it has the defect of being complicated, and requires for its first construction most carefully selected and skilled labor.

But if the first cost is very heavy, the maintenance is extremely easy and economical. We saw a rail taken up and relaid in a few minutes with great precision. In our judgment the principle applied at Liverpool is the true one; neglect nothing in construction so as to reduce the cost of maintenance to almost nothing, and save the ordinary vehicles from the intolerable nuisance caused in much traveled streets by the presence of rails in bad order.

NOTE: As an addendum to the above sketch of English tramway rails we show a rail proposed by Capt. F. V. Greene and for which a patent is applied for. The rail is of steel weighing 40 pounds per lineal yard and the cast-iron stringer under it would weigh 130 pounds per yard. It is to be used in connection with a concrete base and first-class street paving. The renewal then will practically be confined to the wearing surface or rail alone.



RAIL OF CAPT. GREENE.

A Patent L Road Scheme.—R. T. White, the inventor of an elevated railway structure that is attracting a good deal of attention, has secured estimates from the Boston Bridge Company, by which they would agree to erect it for $125,000 a mile, stations and all, the material to be of steel. They would guarantee it to hold any ordinary train loaded to its full capacity. In this system two centre wheels carry each car, guide wheels and idlers above and on the sides keeping it upright and making it impossible for the train to jump the track. Mr. White thinks when the train is in motion, these idlers will not be brought into play, illustrating the effect by citing the ease with which a bicycle in motion is kept from tipping.

Railroads Everywhere.

From all corners of the world we are hearing of railroads projected, surveyed, or in course of building. In Venezuela, for instance, eight or nine different lines of greater or less extent are under contract, surveys are in progress, grading and track-laying are considerably advanced on two lines, and are soon to commence on others. Portugal has granted a concession for a railroad from Delagoa bay in East Africa to the Transvaal border to connect with the Transvaal Railroad, which, it is reported, will be built by German capital. The more progressive among the Boers say they must have railroad connection with the sea. To its railroads is largely due the fact that South Africa now stands tenth on the list of the chief foreign nations dealing with England.

It is in the Oriental world, however, that new railroad schemes are most rapidly advancing. The king of Siam is eager to connect his capital with the Chinese frontier by rail, and has promised to build this road if the Indian government will build a road through Burmah to meet the Siamese system at the frontier. The leading chambers of commerce in Great Britain sent agents to report upon the feasibility of this project, and Messrs. Hallett and Colquhoun have returned home with enthusiastic endorsements of the scheme. In China the powerful viceroy Li Hung Chang has for some time been urging the need of railroads and telegraphs. His influence, aided by the support of other able statesmen, has already given to China over 3,000 miles of telegraphs, manned by Chinese operators, and the little 9-mile railroad near Tien Tsin, and is paving the way for railroad schemes, that it is believed will, in the course of time, reach a large development in China. The railroad that is to connect the chief towns of Siberia is slowly advancing eastward, and surveys for projected lines are in progress in Asia Minor, the Euphrates Valley, and Persia.

The development of some of these projects will be the work of many years, and some of them will doubtless utterly fail. Yet it is one of the most significant signs of the times that these schemes have entered so largely into the purposes and ambitions of the commercial world.—*N. Y. Sun.*

Hoisting from Great Depths.

Prof. J. Hrabak, of Austria, in discussing the means that will have to be adopted to raise ore or coal from depths exceeding 1,000 metres, points out that depth was reached in 1883 by the Przibram mines, and that several collieries are rapidly approaching it. He shows, says the *Colliery Guardian*, that the ordinary method with ropes of any form whatever, will be practically impossible when the ore has to be raised 1,200 metres without the use of supplementary engines placed lower down the shaft, and that even these would not enable the ore to be raised from depths greatly exceeding 1,200 metres. The method that, in principle at least, would enable the ore to be raised from almost any depth, is the pneumatic system which has been in use since 1876 at the Epinac Colliery, in the South of France. The results obtained have been very satisfactory, but as the cost of a pneumatic plant would be greatly in excess of a rope one it is very improbable that it will come into general use as long as it is found practicable to employ ropes. Having this in view, the author proposes a method by which he considers it will be possible to overcome the difficulties attaching to the ordinary rope arrangements. He proposes to increase the width of the shaft for half its depth to such an extent that, besides the two principal winding divisions, two secondary ones could also be arranged. Through the principal divisions the winding would be effected by ropes that reach to the bottom of the shaft, and they would be worked in such a manner that, while half the length of each was wound upon the drum, the other halves would hang down the shaft and counterbalance one another. The ore would be raised by these ropes half the hight of the shaft, and would be lifted the remainder of the distance by the secondary ropes. This method of winding would be expensive on account of the enlargement of the shaft and the necessity for two winding engines. The expense would, however, be compensated for by the winding power being increased by 50 per cent.

English Architects.

Men who live in houses do not build them; they hire them and have a hope—which by this time cannot be called reasonable—that the landlord has built with a view to comfort. Not so; he builds with a view to money, and the tenant suffers every day of the year because the simplest precautions have not been taken in building to meet the changes arising from variation in temperature. It may be wrong to blame the landlord, or even the speculative builder, when the right person to blame is the architect. So far as the outside world may judge, the profession of "architect" is from first to last a delusion and a snare. The only thing the "professor" is good for is to blackguard the Government (or municipal authorities) or private individuals over every bit of work done. No work is ever done by the right person, or is well done. The latter is unavoidable; for what capitalists can decide as to the right party, or how can the man act freely when selected when every other member of the profession is like a tom cat, snarling at every design as a whole, and at every detail in the design? Whoever heard of an architect paying attention to common sense suggestions in designing the miles upon miles of houses in the towns of England? And surely some architect has been consulted in the majority of cases. The aim is to make a something to look at from the outside, while comfort and convenience are of no import.—The *Contractor.*

THE correspondent of an East Indian journal calls attention to the fact that the estimates of distances based upon the movement of sound at the rate of 1,093 feet per second are erroneous. This is its speed at 32 degrees Fahrenheit, and it increases 1¼ feet per second for every degree of temperature, which makes a difference of 75.5 feet at the temperature of 100 degree that prevails in India. The error due to this neglect of temperature, though small for short distances, becomes of much importance in estimating distances, of say 1,000 yards and upwards. To burst a shrapnel shell 75 yards short of the spot where it is intended to burst, or 75 yards beyond that spot, is almost, if not entirely, to destroy its effect, and to misjudge the distance by 250 yards when shelling an intrenchment 4,000 yards off might render whole batteries of guns almost useless.

TELEPHONING 2,465 MILES.—An extraordinary feat in telephoning was recently accomplished between St. Petersburg and Boulogne, a distance of 2,465 miles. Conversation was kept up, notwithstanding a rather high induction. The experiments were made during the night, when the telegraph wires were not at work. The Russian engineers hope to succeed in conversing by telephone over a distance of 4,665 miles.

Municipal Engineering; Paper No. 1.*

BOSTON, MASSACHUSETTS.

Boston, the capital of the State of Massachusetts and of the County of Suffolk, is the chief city of New England. It is situated in latitude 42° 21′ 24″ north, and in longitude 71° 3′ 58″ east.

The town was originally founded by John Winthrop, the usually accepted date being September 7 (O. S.), 1630, and it was named after Boston, in Lincolnshire, England, in honor of Mr. Isaac Johnson, a great friend and supporter of the Massachusetts colony, and a native of the place named. Boston was not incorporated as a city until 1822.

Topographical.—Old Boston was a peninsula, joined to the mainland on the south by a narrow strip of land called the Neck, in some places only 150 feet wide, and bounded by the Charles and Mystic rivers and Massachusetts Bay. This peninsula was about 2¾ miles long, one mile wide at its broadest part, and in total area equal to 783 acres. The original surface was uneven, with three prominent hills, Beacon, Fort and Copp's Hill; the first and third have been much reduced in elevation by the grading of modern times and Fort Hill had been entirely removed, prior to 1873, and the material used in filling Atlantic avenue and adjacent territory. At the present date, Beacon Hill is about 100 feet, and Copp's Hill about 50 feet above sea level.

The city of Boston, as now incorporated, embraces the following divisions:—

Boston proper	area 1829 acres.		
East Boston	" 836 "	formerly Noodle's Island.	
South Boston	" 1002 "	annexed 1804.	
Roxbury	" 2700 "	"	Jan. 6, 1868.
Dorchester	" 5614 "	"	Jan. 3, 1870.
West Roxbury	" 7848 "	"	Jan. 5, 1874.
Charlestown	" 586 "	"	" 1874
Brighton	" 2277 "	"	" 1874
Breed's Island	" 785 "		
Deer Island	" 184 "		

Total area 23,661 acres = 36⅞ square miles.

As will be seen from the above, about 1046 acres have been added to the original area of Boston proper, the additional dry land having been made by filling in the old "Mill Pond" and other ancient coves and water-ways (see Plate 1); this process of making new land is still going on, notably on the South Boston Flats, where the Commonwealth is steadily filling out to a line which will in time obliterate the shallow bay now lying between South Boston and the ground east of Fort Point Channel. This new land is sold by the State for somewhat more than it costs to make it. The Back Bay Park, now under construction, is also gradually occupying territory once under water, as shown by the dotted lines on the map. Unfortunately for the proper drainage of Boston, this added area was only raised from 6 to 8 feet above the level of mean high tide, and this comparatively low ground proved a very troublesome feature when the ancient sewerage system was extended into it.

The streets of old Boston were notoriously narrow, crooked and confusing to the stranger in their eccentric meanderings; but they were to a great extent widened and straightened after the great fire of 1872, about $9,000,000 having been expended for this purpose in 1873-74. In the South End, in South Boston and on the Back Bay, the streets are of good width and generally laid out in a uniform manner. On June 30, 1885, the aggregate length of public or accepted streets, was 381.2 miles; but to this must be added over 200 miles of private or unaccepted streets, a peculiar institution of Boston, which will be treated of under its proper head. The longest highway in Boston is Washington street, which extends from the Bay to the Dedham line, a distance of about nine miles; it is very crooked, however. The longest straight streets are, Commonwealth avenue, 6,250 feet, and East Chester Park, from Albany street to Five Corners, 5,600 feet. The widest street is Commonwealth avenue, 200 feet between the house lines.

The steepest street gradient is 15 feet per 100 feet, on Garden and Irving streets, West End; there are numbers of other streets, however, having grades of 14, 13, 11 and 9 feet per 100 feet. The entrance to Pemberton square from Tremont street, in the heart of the city, has a grade of 8⅞ feet per 100 feet. The principal parks in the city are, Boston Commons, area 49½ acres, and said to have been purchased in 1634 from the Rev. William Blaxton, or Blackstone, the original white settler; the Public Gardens, area 24½ acres and adjoining the Commons; the Back Bay Park, area 106 acres and now under construction, and the West Roxbury and others still in an incomplete state. The highest points of land within the incorporated limits, other than in Boston proper, are as follows:—East Boston, Eagle Hill, eighty-three feet high; South Boston, Dorchester Heights, 137 feet; Charleston, Bunker Hill, 111 feet high, and Breed's Hill, 76 feet high, and in West Roxbury, Mt. Bellime, 331 feet above sea level, is the ma imum elevation within the city limits.

The accompanying maps show that Boston is still much cut up by navigable waterways, mainly inlets from tide water. These channels require eight city bridges of considerable length, and the most of them are provided with draw-spans.

Population.—As showing its rapid growth we extract from the U. S. Census reports the population by decades as follows:—1790. 18,038; 1800, 24,937; 1810, 33,250; 1820, 43,298; 1830, 61,392; 1840, 93,383; 1850, 136,881; 1860, 177,840; 1870, 250,526; 1880, 362,839. The Massachusetts State Census for 1885, just taken, makes the population 390,406. It is estimated that within a radius of 12 miles from the City Hall of Boston, there is now a total population of 700,000.

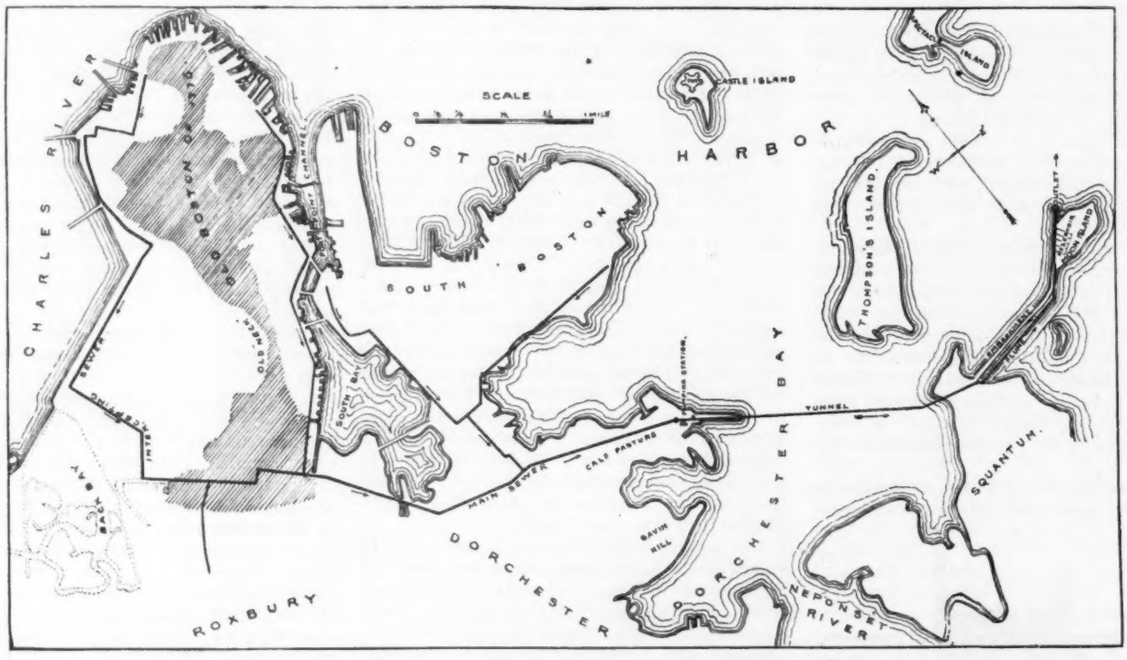


Plate. I.—Boston and vicinity; showing Main Drainage System.

Houses.—Boston can not be called a densely populated city, as far as its dwellings are concerned. The Massachusetts State Census of 1884 gives the average number of persons in one dwelling as ranging from 6.08, in Ward 2, to 12.01 in Ward 6; the average family ranges in numbers from 4.5, in Ward 12, to 6.61 in Ward 10. The City Auditor, in his report for the year ending June 30, 1885, puts the total number of dwelling houses at 43,930; hotels, 88; family hotels, or apartment houses, at 178, and the aggregate number of all buildings, including buildings under erection, stores, etc., at 52,420. The dwellings are very generally built of brick, with a high basement story, but the L-extension, or back-building so common in Philadelphia and some other cities, though found is rather an exception to the general rule. Wooden buildings of all kinds are very plentiful, especially in the older portions of the city.

Climate.—Owing to its exposed condition on the sea-coast, the winter climate of Boston is very severe; the average range of the thermometer can be included between 8 degrees be-

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low zero, and 95 degrees (Fahrenheit) above, though both of these extremes are quite frequently exceeded. The frost penetration into the ground is ordinarily 4 feet below the surface, but in some portions of the city it now and then exceeds 5 feet. The average rainfall, as recorded on the Cochituate Waterworks, was, from 1852 to 1884, 47.95 inches; the greatest rainfall within this period being 69.30 inches, in 1863, and the minimum was 31.20 inches in 1883. The average range of tide in Boston Harbor is officially 9.8 feet; but with a favorable gale it sometimes reaches 13.9 above city datum, and the famous tide of 1851 which carried away the old Minot's Ledge Lighthouse, reached + 15.00

Geology.—The bed-rock under Boston is made up of clay-slates and conglomerates with numerous interjected dykes of material melted by the action of fire. This rock formation occupies a great synclinal, or trough, which from its form has greatly protected the comparatively soft material from erosion and decay. Of the original mountain ridges once bounding this trough, only the roots remain in the undulations of the Milton and Medford hills. Borings made in the central part of this basin show that its floor is at least 1,600 feet below the surface. The beds of the rock are greatly disturbed by the same process of nature which formed this great furrow; they are rent by faults and the average slope can be set down at 22°, though it varies very much. The present surface over this whole region owes its contour to the action of water, and the "boulder-clay" almost everywhere found is the result of glacial deposit. This "clay" is a dense, impervious mass of boulders, sand and mud comingled, where yet undisturbed; and at other points presents alternating layers of these materials as redistributed by water. This mud strata, where compact or over 4 feet in thickness, is impervious to water.

Finances. Property in Boston is now assessed to its real valuation, sales sometimes exceeding and sometimes falling below the assessor's rate of value. The City Auditor's report for the year ending June 30, 1885, gives the total valuation of real and personal property, including $15,219,557 of bank stock separately assessed in the City of Boston, as $682,656,657. Upon this valuation a tax, for 1884, of $11,826,082,19 was raised at a rate of $17 per $1,000; the rate for 1885 has been decreased, however, to $12.80 per $1,000. The total funded city debt, on June 30, 1885, was $42,962,180.02, a decrease of $315,489.05 under the debt of 1883-84. This city debt is classified as follows: City Debt proper, $27,935,706.04; Cochituate Water Loan, $13,045,473.98; Charlestown Debt, $1,002,000; Charlestown Mystic Water Debt, $839,000; West Roxbury Debt, $140,000. The total redemption means on hand at the same date for paying the debt, mainly sinking-funds, was $18,365,600.11; including available and non-available property, the total assets of the city were $64,721,081.16; under the latter head are classed the water-works, property and public buildings of all kinds, cemeteries, parks, etc.

The Mass. Legislature of 1885 have passed an act limiting debt and taxation in the city of Boston as follows: "Section 1.—The taxes assessed on property in the City of Boston, exclusive of the State tax and the sums required by law to be raised on account of the city debt, shall not exceed in any year nine dollars on every one thousand dollars of the average of the assessor's valuation of the taxable property therein for the preceding five years, the valuation for each year being first reduced by the amount of all abatements allowed thereon previous to the 31st day of December in the year preceding said assessment. Any order or appropriation requiring a larger assessment than herein first above limited shall be void.

Section 2. The limit of indebtedness of the City of Boston shall hereafter be two and one-half per cent. up to and until Jan. 1st, 1887, and thereafter shall be two per cent. on the average valuation prescribed in Section 1 of this act, instead of three per cent. on the last preceding valuation, as provided in Section 4 of Chapter 29 of the Public Statutes."

TO BE CONTINUED.

BUSINESS NOTICES.

Wood Creosote for the Preservation of Timber.

For the benefit of all whom it may concern the following notice is given of the methods and practice of the Carolina Oil & Creosote Co., and some of the results of their treatment of timber with wood creosote oil at their factory in Wilmington, N. C.:

Wood creosote oil is obtained by subjecting the heavy resinous pine wood, or the so-called "light-wood," of North Carolina, where it is both plentiful and cheap, to a destructive distillation in closed iron cylinders and condensers. The properties of this product, as a powerful coagulator of wood fibre and its antiseptic properties in the prevention of decay in timber, are too long and well known by engineers to need any further remark. It only remains to treat of the practice of the above company which has the monopoly of the use of wood creosote oil for this purpose in the United States.

In the treatment of pile-timber the plant of the company will handle piling of any diameter up to 16 inches, and any length up to 85 feet; injecting into the sticks form 3 to 20 lbs., of the creosote oil per cubic foot of stick. The experience of users has generally settled upon 12 lbs. per cubic foot as a sufficient charge under the worst conditions of exposure; and to guarantee the quantity agreed upon, the practice of the Carolina Company is to actually weigh one or more logs from each and every charge, both before and after treatment. Ordinary piling is treated first by radiant heat in open cylinders; it is then put into closed cylinders and dried for at least four hours at a moderate heat and under at least 9 lbs. vacuum. It is next surrounded in the same closed cylinders with hot wood creosote oil for four hours under at least 40 lbs. pressure. If only one end of the log is required to be creosoted, that end only is charred, but the whole log is creosoted; the purpose being to secure a *full* dose of the oil for the charred end. Piles thus impregnated with 12 lbs. of wood creosote oil per cubic foot of log, are furnished by the company, f. o. b. at about 25 cents per linear foot of log, the price increasing by from 5 to 10 per cent. for each additional pound of creosote per cubic foot.

Sawed lumber, up to 12 inches square and 85 feet long, can be furnished iniected with from 3 to 20 lbs. of wood creosote oil per cubic foot. This sawed lumber is not charred but is put at once into the closed cylinders, where it is subjected to the dry heat and vacuum for four hours, and hot oil and pressure for eight hours. With lbs. of oil per cubic foot it costs, f. o. b. $25 per thousand feet board measure, increasing in cost as in the case of piling. The capacity of the plant for lumber and piling, up to 85 feet in length, is from 12,000 to 30,000 feet B. M. per day, depending on the amount of oil demanded.

The statements made above are vouched for by undeniable authorities; among the officers of the U. S. Eng. Corps are Gen. Q. A. Gillmore; Lieut. Col. W. P. Craighill; Col. P. C. Haines and Capt. Wm. H. Bixby; added to these are railroad officials and other engineers.

Under date of Aug. 20th, 1885, Capt. Wm. H. Bixby, U. S. Eng's., personally and carefully superintended the weighing of an "every day" charge of wood creosoted lumber during its passage through the various operations of its manufacture, and made an official report as follows: The charge was sufficient to once fill a retort 60 feet long and 6 feet in diameter; it consisted of 35 logs divided into 5 different lots, all put into the retort together. The majority of the logs were taken fresh from the water and they were 30 and 35 feet long and of diameters ranging from 9½ to 11 inches. The results are shown in the following table:

As deductions from this table, we see that under the same conditions of heat and pressure, carbonized logs will absorb nearly 50 per cent. more creosote than when uncarbonized, and that the amount of creosote in a log can be greatly increased by a second passage through the retort.

After the above test two of these logs, one uncarbonized, the other carbonized, were sawn across 4 feet from the end and examined; other logs were sawn across the middle. The creosote in all cases appeared to have deeply discolored the log across its grain to a depth of 3 or 4 inches from the exterior, and to have tinted, scented and flavored the fibres to the very heart of the log; the creosote also appeared to have gone deeper and more uniformly into and through the carbonized log than the uncarbonized. The pressure used was less than 60 lbs., though this could be greatly increased if the changes of creosote per cubic foot were desired to be greater than those given.

WOOD CREOSOTE.

Lots.	Original Condition.	Treatment.	Average Weight in Pounds.	
			Total.	Per Cub. Ft.
A	Green and Wet.	Weighed originally per log	584	39.-
		Lost by light carbonizing	57	3.9
		Gained by steaming	9	0.6
		(Water objectionable)		
		Lost by vacuum drying	9	0.6
		Gained by injected creosote	161	10.7
B	Green and Wet.	Weighed originally per log	794	49.-
		Lost by heavy carbonizing	126	7.9
		Lost by vacuum drying	8	0.5
		Gained by injected creosote	202	12.5
		[Note.—The individual gain by injected creosote in each log was as follows: 11.6, 11.9, 12.9, 10.5, 11.7, 15.1, 8.8, 7.9, 14.2, 11.8, 20.0, and 14.3.]		
C	Green and 4 days Sun-dried.	Weighed originally per log	1163	49.-
		Gained by steaming	7	0.3
		Lost by vacuum drying	29	1.3
		Gained by injected creosote	204	8.8
		[Note.—The individual gain by injected creosote in each log was as follows: 8.9, 11.4, 5.5, 8.3, 10.4, 6.7, 10.6, 10.3, 8.1, 7.5, 9.6.]		
D	Green and 4 days. Sun-dried.	Weighed originally per log	873	45.-
		Gained by vacuum drying	21	1.1
		Gained by injected creosote	176	9.3
E	Old dried Creo'ted Logs.	Weighed in old creosoted condition per log	1069	47.-
		Gained by newly injected creosote	153	6.7

Hazleton, Pa., Water Works.—The water supply of Hazleton is dependent altogether on the rainfall, and consists primarily of a series of reservoirs, five in number, situated on the south side of the town. These reservoirs are about 70 feet in elevation above the intersection of Broad and Wyoming streets. Their united capacity is about 2,000,000 gallons.

In addition to these reservoirs there is another one located about 2 miles in a southwesterly direction from the town, near the mining village of Mt. Pleasant. This reservoir comprises about 3 acres, with a capacity of about 5,000,000 gallons. As there is a ridge intervening between this reservoir and the town, a Worthington pumping engine is used to pump the water over this ridge, after which it flows into the reservoirs mentioned above. The pipe conveying this water is 8 inches in diameter.

The latter reservoir, however, is only drawn upon during the summer months, when the smaller reservoirs nearer the town fail to furnish a sufficient supply.

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A Society of Civil Engineers and Surveyors of Brooklyn is proposed, and a preliminary meeting has been held.

THE report of the Mass. Commission to consider a general system of drainage of the valleys of the Mystic, Blackstone and Charles rivers has just been presented to the Mass. Legislature. We have received an advance copy of the report from Eliot C. Clarke, Chief Engineer to the Commission, and will in another issue give an abstract of this very valuable document.

Herapath's Journal thinks that one of the great prospective railway routes is that from Hudson's Bay south to Winnipeg, thence by the Canadian Pacific and a branch to be built to Benton, Montana, thence by a branch and the main line of the Northern Pacific to Helena, at which point an extension of the Union Pacific will give connection with the railway system leading to the Gulf of California and South Mexico, forming a great route running along the backbone of the continent. It does not need an excessive amount of faith in the future to believe that such a line may within a few years become a reality. All this is possible, but we think the route from Hudson's Bay south to Winnipeg is not a very good tail to wag so long a dog.

THE *N. Y. Tribune* states that Ex-Congressman E. Moody Boynton has invented a new railroad on the bicycle plan, viz:—A single bearing rail with a driver 20 feet in diameter and guiding rail or rails at the top to steady the affair, when standing still or going around curves. Ex-Congressman Boynton expects to attain a speed of 200 miles per hour, which seems theoretically possible as a 6 ft. wheel will make sixty miles per hour.

On a 4 ft. 8½ in. gauge 6 ft. to 6 ft. 6 in. drivers seem about the maximum sizes practicable, as the large boilers, necessitated by our heavy trains, bring the center of gravity uncomfortably high at the figures given. The probable necessity for greater speed that is attainable with drivers of this size has long been recognized. Col. J. W. Adams, some thirty or thirty-five years ago, we think, proposed a large boiler supported on narrow gauge tracks placed on opposite sides. With this arrangement the drivers could be of any desired diameter, and the center of gravity could be kept as low as necessary, but the arrangement would call for four tracks.

Mr. E. M. Boynton is now moving on a different plan, one that should not meet with opposition from narrow gauge engineers. There are doubtless some practical objections to this plan that Mr. Boynton has not fully considered; but theoretically it is good. Getting to Chicago in time to dine after doing business in New York, or on the other hand taking an early leave of business in Chicago and hearing an opera here and being back to Chicago in time for business next day, may not be one of the impossibilities of the future.

THE *Engineer*, reviewing J. S. Jeans' "England's Supremacy," says of his claim that "America herself with all her enormous wealth is still far behind the mother country;" "but though she is not ahead of us she has prospered at so enormous a rate during the last few years, that if this rate of progress be continued for any length of time and our rate is not increased to an unexpected extent, we shall be left far behind in the race for supremacy." Mulhall, who seems to be considered the best authority on national statistics asserts that, though the wealth per capita is greater in England, the aggregate wealth of this country is the greatest and that of the world's yearly increase in wealth we contribute one third.

Few realize the increase of our production; our internal commerce can not be fully ascertained, but our exportations of manufactures, which in the decade ending 1860 averaged $39,000,000 per annum, in the decade ending 1870 averaged about $60,000,000, and for that ending 1880 averaged $124,000,000, while, to the nearest millions, the exports were for 1881 $170, 1882 $187, and for 1883 $188. During this time our people were fed as no people have been fed either before or any where else, and our exportations of agricultural produce has kept fully up to those above noted of manufactures articles, and it is estimated that our daily consumption of wheat is fully three quarters of a million bushels.

Herapath's Journal on the contrary takes a more pessimistic view of our future in accounting for the increase of the wheat traffic on the East Indian Railway as follows:

"It is said that the depreciation of the rupee acts as a sort of bounty. That is one explanation of the revival, but there is another, and to our mind a truer one—the levelling of the superiority which American production had acquired. It is a fight between cheap labor and cheap carriage in India, and virgin soil and cheaper carriage in America. A good harvest and a war of rates give a temporary advantage to the States. The thicker end of the stick, in our opinion, lies with India. Feeder roads, more perfect railway organization, better acquaintance with scientific agriculture, and a restriction on the action of the Zemindar will raise the cultivating ryot into a powerful competitive wheat factor, before which the prairie pioneer will in the end go down. Virgin richness is but a matter of six or seven crops at most; twenty years will see the prairie skimmed and a wilderness; and long before that span has sped, India will be the recognized wheat country of the world."

It is quite possible that India may be the recognized wheat exporting country of the world. Wheat growing for foreign sale in the United States is incident to the poverty of first settlement. No one now looks for Genesee Valley wheat in the market, but according to Edward Atkinson more wheat is now grown in New York than in the days when its price governed quotations. In 1870 47.3 per cent. of those who worked in this country were farmers, and in 1880 only 44 1 per cent., that is, the proportion of those who consume agricultural products, is steadily increasing. Nor can even the English proverbial ignorance of this country excuse the prediction that "twenty years will see the prairies skimmed and a wilderness." Illinois, Iowa, Kansas and Nebraska are prairie states, if any are, and we give their relative ranks in the list of states and populations for census years, calling to mind that 1880 is the only census year that has not recorded a new state.

	Illinois.		Iowa.		Kansas.		Nebraska.	
	Rank.	Population.	Rank.	Population.	Rank.	Population.	Rank.	Population.
1810	23	12,282						
1820	24	55,162						
1830	20	157,445						
1840	14	476,183	28	43,112				
1850	11	851,470	27	192,214				
1860	4	1,171,951	20	674,913	33	107,206	35	28,841
1870	4	2,539,891	11	1,194,020	29	364,399	35	122,993
1880	4	3,077,871	10	1,624,615	20	996,096	30	452,402

No greater mistake can be made than to speak of a state in our Union as in its decadence, because it ceases to export wheat from its borders, while the expenditures of the Indian Government contain the item, "aid extended to famine-stricken districts, £1,500,000," as the budget for 1883-84 did. India will find it not only advantageous but necessary to secure the small net gains that accrue from growing grain for export and, as we intimated above, will probably be the chief factor in the supply of cheap grain, as neither the people of the United States nor those of the Saskatchewan plains will long continue in such a state of poverty as makes the one industry of wheat growing desirable.

THE announcement made on our front cover page that a single American firm has made and sold over 35,000 meters for measuring water, is of more than passing interest, not only to those immediately concerned in the broad subject of water supply, but to the consumers themselves, who, in the end, are really bene-

fited by any check put upon their own wasteful habits in this respect; for the last named must ultimately pay roundly for waste in the shape of taxation for unnecessary extension of their daily supply.

The old-time idea that water should be as "free as air" held good when the only source of supply was the sparkling rivulet or the moss-rimmed bucket of song; then there was no waste, for when the consumer found that some personal exertion and at times a prodigal outlay of muscular force was requisite to get what he wanted, he limited this outlay to actual needs only.

But times have changed; water is free in a sense that past generations never dreamed of, and a constant supply is turned on to every home; there is no longer any necessity for the energetic manipulation of the handle of the time-honored pump or the well-sweep older still; the turning of a simple tap provides a running stream, and the process is so very easy and the supply seemingly so abundant that many forget to turn it off again. The modern consumer rarely stops to consider that someone must pay interest on an enormous outlay for reservoirs, conduits, great pumps and many miles of distributing mains, that coal must be burned and labor furnished, that he may be provided with the fluid he finds so convenient. Waste naturally follows; waste in a hundred ways, that has of late years become such a crying and costly evil that every effort is being made to check it.

So far but two practical methods have been suggested for reducing the amount of water consumed to something near the legitimate requirements of the householder. The one is a system of inspection by personal visits and the aid of various mechanical contrivances attached to the mains or service pipes; this first plan is cumbersome and objectionable to many householders, and while the fact can often be established that there is waste somewhere, it is not so easy to localize and stop it. The second system involves the use of a tireless, ever-working machine, one that experience in use and mechanical skill has now so perfected that all water passing it is accurately measured and the quantity recorded. This little detector says to the consumer,—take all the water you want, and let all that you do not want run to waste,—but I have an eye on you, and when the bill comes around you will find the total quantity nicely reduced to hard dollars, which you will be expected to pay. The consumer may object, but there is his pro-rata consumption of a marketable article, and the bill must be settled, or he must go back to his now contaminated well. The argument is usually convincing, and as a rule the first quarter's bill paid for metered water is the largest collected from any individual householder.

It is only natural that many citizens should object to the use of the tell-tale meter; they prefer to be untrammeled in their expenditure of water. But the nominal consumption per capita has reached such startling figures that even the tax-payers are taking some interest in the matter at last. In Boston, by the use of household meters, and the Deacon meter on the street main, the consumption per head has been reduced in a little more than one year from 91½ gallons to 68 gallons; and the saving for the year 1884 amounted to an average of 8,292,742 gallons per day, as compared with 1883. If this quantity could have been sold at $1 per 5,000 gallons, the meter-rate of Boston, the money value of this amount of water would be just $1,658.40 *per day*, or the enormous sum of $605,316 for the year. From this showing it would seem that "waste-prevention" pays a very fair return.

Municipal Engineering.

In publishing with this issue the introductory chapter of the first of our proposed series of papers on Municipal Engineering, it may be well to again briefly outline the plan to be followed and some of the controlling reasons for the adoption of this plan.

The term "Municipal Engineering" is used in its broadest sense, it being intended to cover as much as possible the duties and practice of the departments of a city government which have to do with the construction and maintenance of public works and have certain control over the actions of private individuals and corporations. The purely legislative departments and those in charge of what may be called the morals of the community will have no place in this series of articles, as being foreign to their purpose.

This particular branch of engineering science has never been written up in a connected form, for the very good reason that the subject is one that does not admit of a general treatment, or the application of any universal remedy to existing evils. Cities differ widely in their location, topography, soil, climate, and the traditions and habits of their population, and no fast rule will apply equally well to each and every case. There are always certain controlling conditions and circumstances that, for either good or evil, exert a strong influence on the management of public works and their extension and maintenance. The phenomenal growth of American towns has exceeded the wildest dreams of our ancestors, and our great cities are now chiefly engaged in correcting the innocent blunders of men, who in planning for the future utterly failed to appreciate the rapid increase in population and area brought about in one or two generations, and the extent of the demands of a modern civilization.

This improvement is forced upon us, though some of our American towns seem to require a deal of pushing. A large city may be compared to the human organism; its veins and arteries should be of ample size and unclogged, its circulation should be good, and outwardly and inwardly it should be clean. Neglect of these conditions will as surely bring disease and decay in the town as in mankind.

Finding it impossible to handle the subject as a whole, we have now undertaken to give separately the actual practice of the larger American cities in whatever relates to the construction and maintenance of public works; giving this practice as we find it, but with such comment as may be considered proper. And that all the controlling conditions may be better understood, we will in each case preface our articles by sufficient historical data to fix the age of the city to be described; give the topography, soil and prevailing climate; the extent and growth of the population, and finally the financial condition of the city.

In treating of the several departments in charge of public works and their methods, there will doubtless be more than one question of detail unanswered; but space forbids writing an elaborate treatise on each one of them. The manner of appointment and the duties of the official head of departments will be clearly explained, and anything peculiar in the practice of a department, or in tools used, that it is thought would add to the store of useful knowledge on this subject, will be described, and illustrated. In relation to sewerage and water supply the description will be very general as to plan, but interesting bits of detail will be shown, especially if these are good and susceptible of use elsewhere.

Our readers will find in this Boston series abundant quotations from the ordinances of the city. The wisdom of giving these place was at first questioned; but when we considered that these smaller details were generally the least known and yet of the most frequent application, it seemed best to let them stand, even at the risk of their proving dry reading to some of our patrons. This latter class can skip them; others will perhaps find there just what they want.

In the description of each city the same general plan will be followed as nearly as the form of city government will permit, so that similar subjects will be treated in about the same sequence. We hardly need tell those familiar with the methods, or rather lack of any method, of some of our cities, that there will be some important points that, from want of proper record, can not be given in as full detail as we or our readers would wish. But whatever persistent and intelligent investigation can do, that will be done.

We propose also to give with each city a general map; that for Boston is yet in the printer's hands, but we hope to have it in time for our next issue.

"Experts" on the Quaker Bridge Dam.

For utter nonsense and a profound display of personal ignorance of what he was talking about, commend us to the late speech of a Mr. Arnoux—a lawyer, we understand—before the Aqueduct Commission.

Space is too valuable to give the speech of Mr. A. in full; but in attempting to draw a parallel between the estimates of the city's engineers on the proposed Quaker Bridge dam and those on the Panama Canal, he bases his remarks upon the slim evidence "of a friend of mine" who once passed over the Panama R. R. This eminent authority refers to the Panama work as "a mere canal, open, visible and with no problematical scheme connected with it;" which will be news to a number of interested individuals who have been struggling for some years past with rather an intricate series of problems. M. de Lesseps, too, is an "engineer of world-wide reputation," and the aqueduct engineers — Messrs. Chesbrough, Jervis, Francis and Church, Fteley and Davis —"certainly can not claim to be the peers of this man;" considering that the famous Frenchman himself emphatically says that he is *not* an engineer but only a diplomat, this comparison is uncomplimentary to men who have devoted a lifetime to the practice of engineering and who have very generally been regarded as authorities upon this subject, that is, at least by those who are supposed to know what an "engineer" is.

Mr. Arnoux then continues with some wild talk about a "third Chagres river dam" now building to replace two dams previously swept away; but as this information is also derived from that "friend of mine," it is hardly fair to place it in evidence against the statements of *engineers* who report that so far from the *first* Chagres dam ever having been built and already carried away, the plans for this first dam have not yet been completed.

For the sake of his clients, we trust that the practice of this lawyer-engineer before the courts of justice is based upon sounder data than are his supposed engineering opinions and statements.

But for extreme richness and the startling nature of the engineering theory and practice advocated before the Commission, we do not think that the proceedings of December 16th can be surpassed.

Upon that fateful day a new engineering light flashed meteor-like upon the professional horizon and with a few brief lightning strokes of wisdom blotted out nearly all the pet theories on "big dams" that have been

held, not only by such men as we have already mentioned as interested in the New Croton Aqueduct, but also by the de Sazillys, the Delocres and other famed experts of Europe.

As a matter of future historical and professional interest, we record the name of this prodigy imported by Congressman Potter; it is Edward E. Glaskin, with a large "C. E." This engineering iconoclast, on the day mentioned, startled the "Wise Men of Gotham" by stating that there was one question which had never been discussed before the Aqueduct Commission—remarkable to say—and that was the effect of the expansion and contraction of a mass of masonry 1,350 feet long, such as would be found in the future Quaker Bridge dam. He had made a careful study of this neglected problem, and from his figures he had evolved the fact that with a range of temperature of 120 degrees the dam would expand and contract in its length through a distance of 15½ inches, and that the gap at the very bottom would be 4¾ inches.

This is a serious matter, and we can imagine the surprise of Mr. G. at not finding in the plans of the aqueduct engineers the slip-joint or other mechanical contrivance necessary to overcome this awkward tendency in the dam to crawl about, which "must be provided for in some shape or form." He supposes that the aqueduct engineers will seek to cover their blunder by the statement that the "elasticity of the masonry" will compensate for any such changes due to temperature; but this will not do. "The masonry will be laid in summer when it is most expanded, and in winter it will pull at least 15½ inches;" and "the amount of force that is required to pull or crush that block of granite through that expanse is the exact amount of measure of that force with which that dam will pull away from the sides of the dam."

To still further complicate the problem whirling through the brain of this expert, the range of temperature on the water side of the dam will only be through 40 degrees, while the other side will be subjected to variations of 120 degrees. This idiosyncrasy taken in connection with the tendency to open and shut lengthwise is likely to result in a very demoralized dam in the course of a few seasons.

But like all good doctors, Mr. Glaskin boldly grasps the situation and suggests a remedy for these evils. The first is, to make the top of the dam twice as wide as it is, "thus making it a great conservator of temperature; it will give out in winter the heat that is poured upon it in summer, and in summer it will give back the cold of winter. So it will be constantly taking in and giving back the temperature, and it will be a great conservator of temperature." This "conservator" can also be provided by "covering back of dam 40 feet wide"—whatever that may mean—and thus "keeping the sun's rays from the back of the dam and keeping away the cold of winter and taking in the heat of summer." The engineer kindly informs us that the difference in the cost of "rock" required to accomplish this end would be exactly $600,000. The top of the dam must also be covered by an umbrella of some kind, to keep the sun from tanning its rocky face probably.

The expert simply mentions these points "because they have not been included in any specifications I have seen," and he thinks it is only justice to the public "to know just what means the chief engineer has adopted to overcome these difficulties."

At the end of Mr. Glaskin's testimony, the Commissioner of Public Works propounded a conundrum to him concerning the High Bridge, which is a masonry structure just 1,400 feet long. When asked what effect he supposed contraction and expansion would have on that, he replied that he believed it would be just about the same as he had figured for the dam, 15½ inches. When he was informed that the most careful examination running over a period of many years had fixed the maximum movement at ⅛ inch, and he was asked what he had to say to that,—this wily expert replied—"Only this; that that is a north and south structure while this is an east and west dam!" Mr. Glaskin, however, thought the figure given for the High Bridge as "very remarkable."

We have no comment to make upon the above, save to remark that it is fortunate for Mr. Potter that there is "free trade" in engineers at least; for America could never have produced an expert with views quite so original as are here set forth.

But we do not believe that the members of the Aqueduct Commission are paid $8,000 per annum simply to spread upon their minutes such professional nonsense as they have, for about two years, been patiently listening to. With some of the best hydraulic engineers in the country already in its direct service, with the advice of the highest authorities practically secured, and the power to call for additional light from the only men who can furnish it; there is neither necessity or excuse for recording the wild flights of fancy of every unknown engineer who chooses to appear before the commission. The commission or its engineers should sit down hard upon these men who simply seek a fee, and the cheap advertising their puny efforts will secure for them. The only consolation that can be derived from much of this "expert" testimony is, that if it ever should be decided that brass was a fitting material with which to build or line the dam, there would be little difficulty in securing the requisite quantity.

Chinese Railroads.

The new Chinese loan of £35,000,000 is to be issued in London and Berlin. It is known that the loan is to be expended chiefly in railway construction, and there is now going on an eager competition for the construction contracts between English and German houses.

Herapath's Journal says that the prize of railroad construction and management "in China will be between the Germans and us. The Americans are out of it. In financial circles in Berlin it is stated that three gentlemen, representing the Discount Bank, the German Bank, and the firm of Messrs. Krupp, will leave Germany in a few days for China to make a thorough practical study of the railway question in that country. The emulation of German capitalists has been roused by the rumours of British enterprise in the Chinese Empire, and they would seem to have already resolved to secure, if possible, a share of the spoil before it is too late. For this purpose the private mission referred to will proceed to China with the view of inspecting the ground and seeing what can be done in the way of frustrating an English monopoly in the construction of Chinese railways." We are sorry to think that we *are* out of the race. We have so long been a borrowing nation that it does not seem possible to our capitalists and investors that we should occupy foreign fields of labor, and the education to other views will be difficult. If our manufacturers understood the great influence that is exerted on the tastes and habits of a country by such a body of engineers with the clerks, foremen, etc., as is required to survey and build railroads in a foreign country, they would take more interest in projects that promise to be mutually advantageous, as for example our total exports to Mexico which in 1879 were $6,752,244, in 1883 had increased to 16,587,620.

Germany seems determined to become the chief servant of China, as she is now building two war vessels for the Chinese Government, in addition to those already delivered.

The Euphrates Valley Railway.

The attention of England is again directed to this route by an article in the *Railway News*. The proposed line will extend about 920 miles from Alexandretta on the Mediterranean to Grain at the head of the PersianGulf, where it would meet a line of powerful subsidized steamers now maintained between that port and Kurrachee. The country is said to be admirably adapted for the construction of a railroad, and the cost is estimated at £5000 to £3000 per mile. The estimated time between London and Kurrachee is fourteen days. If the boat transit from Grain to Kurrachee was replaced by railroad, the time would be reduced to ten days.

It is claimed this route would shorten the distance to India 1,000 miles, and make Kurrachee the port of India instead of Bombay, and allow England to make Chatham or Southampton the base of offensive or defensive operations in India instead of Indian ports. It also follows that England would soon own the country its road passes through, and would be able to more effectually prevent Russia from getting access to the sea, via Afghanistan, and it was, we suspect, a desire to keep Russia from becoming a maritime power rather than any fear for her Hindoos that caused the trouble about the Russian advance on Herat.

Italy. Proposals for Rolling Stock.

The directors of the Mediterranean Railways are receiving tenders, not only from native firms, but from abroad for 10 first-class carriages on four wheels, 5 second-class carriages of the normal type with four compartments, 10 third-class furnished carriages, 20 four-wheeled luggage vans, 40 covered four-wheeled goods and cattle wagons, with brake, and 40 without brake, 552 axles with bolts, 178 axles with safety hoop, and 3,294 springs of various kinds.

By the new law, giving bounties for merchant shipping, lately sanctioned by the King, it is arranged that during the next ten years a premium of 60 fr. per ton will be paid to the constructors for all vessels, either iron or steel, steam or sailing, built in Italy. For barges the premium is 30 fr. per ton. However, vessels that have only the frame work of iron or steel, are not to share in the premium. For marine engines constructed in Italy a premium of 10 fr. per indicated h.-p. will be paid, and for marine boilers 6 fr. per quintal. The premiums may be increased by 10 or 20 per cent., where the vessels are so designed as to be also available as ships of war. The regulations (19 April, 1872, 30 May, 1878, and 31 July, 1879) admitting materials for the constructors duty free are withdrawn. A premium of 1 fr. per ton is to be allowed on coal imported in Italian vessels from beyond Gibraltar.—*Iron and Coal Trades Review.*

The Congo and Colored Laborers.

King Leopold says that he has money enough secured to build the portage railroads necessary to connect the navigations of the Congo. And Consul General Raine writes that the German Government has subsidized two steamer lines to run to her African colonies, while a third line has just been estab-

lished by private enterprise between Hamburg and the Congo (monthly). In our last issue will be found a notice of telegraph extension past the same place.

All this looks as if the recent accounts of the worthlessness of the Congo regions for trade purposes were by interested traders in possession who fear interference from outsiders, an opinion strengthened by some notices in a late number of *Bradstreet's* which say in substance that, though the commerce of Africa like that of all other countries is depressed, there are not wanting indications that a revival of traffic is close at hand, giving the imports into the Congo country from last year as £888,000 and the exports from it as some £2,000,000, making in round numbers £3,000,000. The same article speaks of three British trading companies, two lately formed, and of a new steamer line shortly to be started from Southampton besides the African S. S. Co. and the Hamburg line spoken of above.

But whether the country offers any advantages for trade or not, the railroads seem certain to be built, and those we ought not only to equip with rolling stock but to build, as we have many contractors who are used to handling colored laborers, and these laborers, who are skilled in railroad and river work, have confidence in the contractors. Their efficiency over Europeans is too apparent to require comment, and though some would doubtless fraternize with the natives and some give up working, those that were steady would be more effective in inducing the inhabitants to work than white men.

The Brooklyn Bridge Report for 1885.

The following is taken from the annual report of the Board of Trustees of the New York and Brooklyn Bridge for the year ending December 1st, 1885:—

In the twelve months the receipts have been, for promenade, $23,011.34; carriage-way, $58,468.32; railroads, $537,435.09; total, $618,914.75. This is $84,921.75 in excess of the receipts of 1884. The total number of passengers carried on the railroad in the year ending December 1st, 1884, was 8,529,840; while 17,023,237 passengers used the railroad in 1885, but there were 328,911 less foot passengers in the latter year. The whole number of passengers on footway and railroad in 1885 was 8,161,486 in excess of the previous year, or in total, 20,625,326 for the last year. The total revenue from tolls since the opening of the bridge on May 25th, 1883, was $1,291,680.75, received from a total, to December 1st, 1885, of 34,418,366 passengers.

The schedule of tolls is since March 1st, 1885, as follows:—

Foot passengers	1 cent or 25 tickets for 5 cents.
Railroad fare	3 cents or 10 tickets for 25 cents.
One horse or horse and man	3 cents.
One horse and vehicle	5 cents.
Two horses and vehicle	10 cents.
For each horse beyond two, attached to any vehicle	3 cents.
Neat cattle, each	5 cents.
Sheep and hogs, each	2 cents

In referring to the "grip," Col. Wm. H. Paine in his report to the President says:—

"The original designs of the bridge, made by the Roeblings, contemplated the use of cable traction for hauling the cars, and the earliest report on the feasibility of the bridge mentioned two systems: the alternating and the circulating. The bridge was otherwise nearly completed when the latter system was finally adopted so that the arrangement of the terminal stations and other necessities to this system were imposed upon the finished work. The earlies: plans proposed the use of cars of light construction with side doors. The circulating system called for elevated stations at the ends with approaches passing over the roadway, and with grades so arranged as to allow the trains to run by gravity to the place for receiving passengers and gripping the cable. But the construction of the elevated railroad before these plans were carried into effect caused changes and modifications to be made in many respects.

"Much trouble has been experienced in the endeavor to meet the present and anticipated future enlarged requirements of traffic, while limitations and restrictions have been constantly imposed, lessening the space and facilities for operations. The engineers were led to expect that the requirements and rights of the two cities would be maintained, and no curtailment of them would occur to prevent their plans being carried out.

"The system as now in operation is as follows: The cars are hauled by an endless wire cable one and one-half inches in diameter, 11,450 feet in length, and weighing 40,000 pounds. This cable is driven at a uniform speed of ten miles per hour by one or both of two engines, acting through the medium of two drums, each 12 feet in diameter. The engine cylinders are each 24 inches in diameter, with 48 inches stroke. The limited area at each terminus permits the use of but thirty (30) cars; they are all that can be used and stored at one time. The New York terminus limits the length of trains to two cars of 48 feet in length, or three cars of 35 feet long. There are now in use eighteen of the former and twelve of the latter.

"The minimum headway, or least time between trains, is limited by the time required to discharge a load of passengers. This is found to occupy at least forty-five seconds, to which is added one and one-quarter minutes as the shortest interval between trains during the most crowded hours of travel, which interval is increased during the less busy hours of the day. With these limitations there are now about 2,000 single car trips made per day, carrying an average of more than 60,000 passengers.

"During the past month there have been made 57,678 single car trips, carrying 1,829,634 passengers; during the past eleven months there have been made 558,870 single car trips, carrying 16,161,437 passengers.

"The immunity from accident has been without a parallel on any similar road; only two passengers have been in any way injured, and those but very slightly.

"The cable, which cost $5,315.76, has been in daily use for two years and two months, and although it has hauled more than 12,000,000 tons, is still in excellent condition for further service.

"It is evident than no other system of traction could have fulfilled the conditions imposed upon this road.

"While the system has accomplished more than any other could have done, it has been done with less danger to passengers, less strain on the bridge, greater economy in operating, and I may say, with less delays than has occured on other roads."

The chief engineer and superintendent, in a recent report, says:

"The grip now in use on the bridge was invented by Col. W. H. Paine, and has been in use from the first on the bridge railroad.

"It consists essentially of four cast-iron wheels so constructed that the circumferences hold securely a lining of rubber and leather which has a groove in the edge to receive the traction rope. These wheels, which are arranged in two pairs opposite each other, are pressed together by means of wooden blocks acting upon the inner sides of the rim nearest the cable. The blocks are moved by a pair of arms toggled together so as to exert great power. These arms are operated by a continuous chain extending to the ends of the car, and connected by gears to the break-shaft, thus greatly multiplying the power exerted on the brake-wheel.

"The mechanism is so arranged that when the cable first comes in contact with the wheels, they commence revolving, and continue to revolve until the friction of the wooden blocks upon tho rims of the wheels is sufficient to impart to the cars the same motion that the cable has when, by means of a solid dye or clamp, the cable is securely held.

"The advantages of this plan are numerous.

"First—Heavy trains are started without shock or jar to the cars, and without undue strain on the traction machinery.

"Second—The cable when in motion only comes in contact with the revolving surfaces of the wheels, and even then with the soft surface of leather and rubber. The advantage of this is that the cable is not abraded by the grip; and, further, should there be a loose wire in the rope, it would be rolled back into place by the grip instead of being shoved forward, forming a knot and destroying the cable.

"Third—In case of emergency the cable is pulled out of the grip without injury to the cable, the grip, or the car.

"This grip is without doubt the best ever invented for the bridge service, and as irrefutable evidence of its efficiency it is only necessary to call attention to the immense weight of cars and passengers which it has taken over the heavy grades of 171 feet per mile on the bridge without serious mishap; and to prove that the wear upon the cable is very slight, attention is called to the fact that notwithstanding the enormous tonnage transported, the cable, which has now been in use for two years and two months, is still in good condition."

The committee appointed to report upon the mechanical, terminal and transportation facilities of the Bridge ordered in the last year the running of trains all night by locomotives at intervals of 15 minutes from 1 A. M. to 5 P.M; they report that this plan has proved an accommodation to the public and is profitable to the bridge. The same committee says that it is not possible upon the existing bridge to arrange a switch whereby a train of more than two cars can be utilized. They believe that the public welfare demands the extension of the tracks on the New York side, and they only await such action of the courts as will enable them to instantly remedy the deficiency in train length. With the terminus at the west side of Chatham Street, trains of four and five cars can be used.

The connection made with the elevated railroad on the New York side in July cost $852.44; the timber work is temporary only, but the connection has proved very beneficial, as it gives 19 feet of abditional track and permits the running of two long cars or three short ones and the carriage of 25 per cent. more passengers in a train than before. It has demonstrated the value of the contemplated extension across Chatham Street.

As twenty-eight of the thirty cars were at times in use during September, the Trustees ordered six new cars from the Pullman Palace Car Co. at a cost of $3,775 each.

The fitting up of the six arches under the New York approach, between Vandewater and Rose streets, cost $50,000, and "there is a yield of about 25 per cent." The estimated cost of fitting up the remaining twenty-five arches is about $250,000, and the estimated rental is $60,000. The trustees are now fitting up four more of these from the accumulated rents of the others; they expect $10,000 annual revenue from them. The demand for the Brooklyn arches is not so great.

The total rents collected for bridge property amounted, in 1885, to $43,835; and as the charge is $30 per annum for each wire stretched across the bridge, the receipts from 292 wires were $8,980. The gross receipts from all sources for 1885 were $721,622.09; and the gross expendit res $577,276.21; leaving the net receipts for the year, $144,345.88. The expenses of providing for 12,460,480 passengers in 1884 exceeding the expenses of providing for 20,625,326 in 1885.

C. C. Martin, chief engineer and superintendent, reports for his department as follows:

Round trips:	Traction Engines	292,477	
	Locomotives	6,418	298,855
Miles run:	Traction Engines	657,979	
	Locomotives	14,440	672,419
Passengers:	By Traction Engine	16,725,173	
	Locomotives	298,064	17,023,237
Weights in tons;	Cars by Traction Engines	6,512,194	
	Passengers by Locomotives	1,170,762	
	Cars by Locomotives	151,891	
	Passengers by Locomotives	20,864	
	Locomotives	192,540	8,048,161

PERSONAL.

The address of J. T. Dodge, C. E., is now Helena, Montana.

John Brunton, City Engineer, of Helena, Montana, was in New York last week, and favored us with a call.

Mrs. Lena Lindsey Follett, wife of W. W. Follett, Civil Engineer, of Shreveport, La., died in that city December 29th, from nervous prostration. The deceased lady was born near Lockport, N. Y., twenty-two years ago. Although a resident of Shreveport only a

few years, by her amiability she had won many friends and was highly esteemed by all who knew her.

HARRY MILLER, of Richmond, Ind., has been appointed engineer of maintenance of way on the first division of the C., St. L. & P. R. R.

JOHN SCHUCH, a well-known contractor and ex-alderman, is missing from Joliet, Ill. It is feared he has fallen in the river and been drowned.

ISAAC DERRIMORE, has been appointed superintendent of the New Albany, Ind., water works, reservoirs and grounds in place of Daniel Bostock, retired.

J. H. BARRETT, superintendent of the Dayton and Union Railroad, has been appointed superintendent of the eastern division of the Erie Railway in place of E. O. Hill, resigned.

R. L. ENGLE, for several years past connected with the Atchison, Topeka and Sante Fe, R. R., Atlantic and Pacific R. R., Mexican Central R. R., and Denver and Rio Grande R. R. as engineer in charge of construction, has been called to the construction department of the Chicago, Burlington and Northern railroad.

WINFRED H. BENNETT, who has been elected city engineer of Manchester, N.H., for the present year, is a native of that city, having been born there January 13, 1860. He is a graduate from the public schools of Manchester, graduating from the Lincoln grammer school in '75 and the High School in 1878. Soon after the completion of his school course he entered the office of the veteran surveyor and engineer, J. B. Sawyer, and there learned civil engineering, being under Mr. Sawyer's charge two years and a half. Subsequently he was employed in the office of a Boston engineering firm, and in April 1883, entered the office of the city engineer in Manchester, where he has since remained.

JAMES MOYLAN, who has just returned to New York from Albuquerque N. M., where he has been engaged as Engineer of Maintenance of Way, on the A. & P. R. R. was the recipient of a complimentary dinner at Martinellis' Fifth avenue restaurant on Saturday evening, January 9th, tendered him by a few of his personal friends. Among the guests were E. W. Harrison, engineer for the N. J. R. R. Tax Commissioners, Henry W. Post and C. A. Billings, of the firm of Post & McCord; J. C. Payne, Frank H. Earle, R. N. Billings and Charles Hopper, civil engineer form Jersey City. Fred. S. Cook and R. M. Watson of the New Croton Aqueduct engineer corps, and Colin R. Wise and Alfred Lucius, of the Brooklyn Elevated Railroad.

WILLIAM BEARD, a well-known contractor, died at his home in Amity St., Brooklyn, this week age eighty-five. He was born in Ireland, but came to this country when fourteen years of age. He began his career in Harlem, where he had several contracts for grading lots. He graded third avenue from sixtieth to eighty eighth St. and also the Bloomingdale road at several points. His next contract was for constructing the Harlem Railroad from Centre St. toward Harlem River, cutting through the rocks at Murray Hill, etc. About 1835 he moved to Brooklyn and built the Brooklyn and Jamaica Railroad from South Ferry to Bedford. He paved Myrtle Avenue, Atlantic street, Union, Strong place, Montague, Pierrepont, Joralemon and Ewen streets. From 1881 to 1858, he carried on several important contracts in various parts of the country, among them being the Government contract to improve the Muskegon River at Grand Rapids, Michigan. He also built the Atlantic Docks and other warehouses and docks from Red Hook Point to South Ferry, and the break water at the Erie Basin.

The Annual Meeting ot the American Society of Civil Engineers.

The following general programme has been issued for the Annual Meeting of the Society on January 20 and 21 next at the Society's House 127 East 23rd street.

Wednesday, January 20th.—The Meeting will open at 10 o'clock. The Annual Reports will be presented; officers for the ensuing year elected; the awards of the Norman Medal and of the Rowland Prize for the past year announced; the replies from members to circulars in reference to the next Convention will be presented; the time and place for the Convention considered; reports from committees on technical subjects presented and discussed.

Lunch will be served at the Society House at 13.30 o'clock (1.30 P. M.). After lunch the session of the Society will be resumed.

In the evening a meeting will be held. The technical reports may be discussed. Mr. B. S. Church, M. Am. Soc. C. E., Chief Engineer of the Aqueduct Commission, will address the Society on the subject of the works in progress and contemplated, for securing the additional water supply to the City of New York. Illustrations of the details of the work will be exhibited.

Thursday, January 21*st.*—An excursion will be made to the Croton River and to the line of the New Croton Aqueduct. It is intended to visit the site for the proposed great dam, the valley of the river above the dam, the location of the gate-houses at the head of the New Aqueduct, and various points along the line, so that the shafts, the tunnel in progress, the aqueduct under construction, and portions of the finished aqueduct may be inspected.

Mr. B. S. Church, M. Am. Soc. C. E., chief engineer of the Aqueduct Commission, invites the society and its guests to lunch at the gate-house at Croton Dam.

The party will leave the city by the Hudson River Railroad from the Grand Central Depot, Fourth avenue and Forty-second street at 9 in the morning.

The return to the city will be over the New York City and Northern Railroad, the route of which is, for a considerable distance, within sight of the line of the Aqueduct.

On arriving at the terminus of the road, the cars of the Elevated Railway will be taken to 125th street, when, by invitation of Mr. Lewis Lyon, the President, and Mr. William H. Paine, M. Am. Soc. C. E., the engineer, a visit will be made to the Tenth Avenue Cable Railroad, now in operation.

In the evening a reception for gentlemen will be held at the House of the Society, and at 21.30 o'clock (9.30 P. M.) supper will be served in the Library.

B. S. CHURCH, WM. H. WILEY,
J. P. DAVIS, G. W. MCNULTY.
F. COLLINGWOOD, JOHN BOGART,
Committee.

Engineers' Club of Philadelphia.

RECORD OF EIGHTH ANNUAL MEETING.

January 9th, 1886.—President J. J. de Kinder in the chair; forty-five members present.

The Secretary and Treasurer presented his Annual Report.

The receipts were $4,588.87; the expenditures, $4,101.42, and the cash balance, $609.40.

The total assets, in addition to the value of the library and furniture, amount to $1,498.47, and the total liabilities to about $15, for which bills have not yet been rendered,=$1,483, net.

Comparison with the balance of last year, after subtracting the advance dues from each, shows the balance of this year to be $728, and of last year $781, which is apparently $53 in favor of the prosperity of last year, but not so when it is considered that the actual expenditures of this year were $706.37 in excess of those of last year.

The membership now consists of 3 Honorary, 5 Corresponding, 423 Active and 8 Associate. The net increase during the year has been $18\frac{3}{10}$ per cent.

The residence of the Active Membership is distributed over about twenty-five States and five foreign countries.

226, or $53\frac{4}{10}$ per cent., reside within, and 197, or $46\frac{6}{10}$ per cent., without, the City of Philadelphia.

The hand of death has been laid upon four of our best members: Theodore Bergner, Dwight Edward Pierce, David Hudson Shedaker and James Worrall.

The Retiring President, Mr. Joseph J. de Kinder, read the Annual Address. The usual review of the Engineering of the past year is given. Special mention is made, with much interesting description in detail, of the following proposed or progressing works: the Panama, Manchester, enlargement of Suez, Corinth, Baltic and North Sea, new Chesapeake and Delaware, Hennepin, Paris and Dunkirk and Gulf of Siam and Indian Ocean Canals; the reclamation of land in Russia and Missouri and Arkansas; the Baltimore and Ohio at Havre de Grace, Tay, Forth, St. Lawrence, Ohio at Henderson, Ky., and St. John Steel Cantilever Bridges; the Croton and Washington Aqueducts; the Mersey, British Channel, Prince Edward's Island and Chicago River Tunnels; the Tehuantepec Ship Railway; Railroads in China, Japan, Russia and America; the London and Southwestern Railway Station; Ship Building and Gunnery; the Flood Rock Excavation; Natural, Hydrogen and Saw-dust gases; the progress in Electric Lighting and Power; and concluding with Water Supply, Sewerage and general Municipal Engineering.

He specially recommends that the latter be made a special question of study and discussion by the Club, and asks if it would not be profitable to ourselves and to the interest of the City if the Club would make Engineering of Philadelphia and its public improvements a leading topic in the future.

The Tellers of Election, Messrs. E. S. Hutchinson and C. Frederick Moore, reported that the following have been elected Officers for 1886:

President—Mr. Washington Jones.

Vice-President—Mr. Thomas M. Cleemann.

Secretary and Treasurer—Mr. Howard Murphy.

Directors—Messrs. Frederic Graff, Rudolph Hering, William A. Ingham, Col. William Ludlow and Henry G. Morris.

Mr. Washington Jones took the chair for 1886 with appopriate remarks.

HOWARD MURPHY,
Secretary and Treasurer.

Ohio Society of Surveyors and Civil Engineers.

The Seventh Annual Meeting of this Society began on Tuesday and ended yesterday, at Columbus, Ohio. The programme, besides the usual routine business of the opening session, included the following papers and reports to be read and discussed:

"Connected Levels in Ohio," by C. N. Brown, Columbus, O.; "Practical Geology for Surveyors and Civil Engineers," Prof. Edward Orton, Columbus, O.; "Report of Drainage Committee," E. D. Shreve, *Chairman*, Bucyrus, O.; "Problem of the Just Apportionment of the Cost of Ditch Improvements," by E. B. Opdycke, Bryan, O.; "Open Drains: Their Size, Grade, Bank Slope and Bottom Width," by J. S. Ellis, Berrysburg, O.; "How We Ditch in Crawford County, Ohio," by H. L. Weber, Bucyrus, O.; "Land-Marks, Ancient and Modern," by J. T. Buck, Cardington, O.; "Land Survey," by G. S. Innis, Columbus, O.; "Report of Committee on Land Surveying," J. D. Varney, *Chairman*, Cleveland, O.; "Trials and Tribulations of a Surveyor," by Emanuel Shifley, Bucyrus, O.

Wednesday evening and Thursday morning and afternoon a Meeting of Mining Engineers was held and an exhibition of Plats, Plans, Instruments, Informal Discussions, etc.

"Roads and Canals of Ohio," by D. W. Pampel, Sidney, O.; "Report of Committee on Civil Engineering," R. S. Weitzell, *Chairman*, Starr, O.: "Report of Committee on Blanks and Instruments," W. H. Jennings, *Chairman*, Columbus, O.; "Report of Committee on Highways," D. W. Pampel, *Chairman*, Sidney, O.; "Report of Committee on

Legislation," F. J. Sager, *Chairman*, Marysville,O.

J. B. Strawn, Civil Engineer, Salem, O., is retiring President, and Benj. Thompson, Urbana, O., is Secretary. The published proceedings of this energetic society are very valuable, especially to surveyors; a few copies of each year remain unsold and a list of contents and prices of each number can be obtained from Secretary Thompson, at Urbana, Ohio.

Engineers' Club of St. Louis.

At the Regular Meeting of the Society, held December 30th, 1885, the following amendment to Sec. 2 of the By-Laws was presented by the Committee:

"The annual dues shall be, for resident members four dollars, and for non-resident members, fifty cents in addition to the price of the Journal."

Prof. J. B. Johnson presented a paper on "The Adjustment of a Quadrilateral."

Messrs. McMath, R. Moore, J. B. Johnson, Holman and Ockerson were elected a committee "to consider and report upon such questions as relate to the conduct of our National Public Works, and to act in conjunction with similar committees of other societies;" this committee to be entitled "the standing committee on National Public Works and that its chairman be a full member of the Civil Engineers Committee on National Public Works as suggested by the Cleveland Convention, but no action of this committee shall be held as binding this Club until it shall have been reported to and endorsed by the Club."

The conclusions of the Cleveland Convention were referred to the standing committee to report at next meeting of the Club.

THOS. D. MILLER, *Sec'y.*

Nebraska Association of Engineers and Surveyors.

OMAHA, Neb., January 5th, 1886.

The Third Annual Meeting of the Nebraska Association of Engineers and Surveyors will be held in the office of the County Surveyor of Douglas County, Omaha, commencing Monday, January 18th, at 7.30 P. M.

The programme will consist of the reports of the officers and different committees, together with the reading of papers by the different members, with attendant discussions.

CORRESPONDENCE.

Municipal Engineering.

HIGHWAY, FIRE, AND WATER COMMISSIONERS,
ROCHESTER, N. Y., Jan. 12th, 1886.

EDITOR ENGINEERING NEWS:—From the index to your last volume I perceive that you are about publishing a series of articles on "Municipal Engineering," and thereby closing up an important gap in professional literature. The lack of this kind of reliable information in compact and readily accessible form, has forced itself upon my notice painfully during the past year, and I wish you most heartily, the utmost success in your venture, and trust that all engineers in charge of municipal public works of every kind will aid your efforts by liberal supplies of valuable statistics, observations and experiences. An interchange of such facts and data cannot fail to be highly beneficial, to both the professional men and the communities by whom they are employed. With this object in view, I have prepared and caused to be sent out, the enclosed list of questions to the authorities in charge of the public works of other cities. This list was made as short as possible, and the questions framed so as to admit of the shortest practicable reply. Much, however, still remains to be considered in the broad problems presented, and I sincerely hope that the columns of your valuable paper will soon be laden with the much needed information from our own American cities, instead of from the larger cities of Europe, where climatological and other conditions are often widely different from those which must be considered here. Without accurate knowledge of these circumstances, comparisons of costs and expenditures become illusory, and grave injustice is thereby frequently done to thoroughly honest and competent officers, who endeavor to elevate the local standard of executing and maintaining municipal public works. The statement to the public generally, that the cost of municipal government in London, Paris and Berlin, amounts to a certain sum per inhabitant, may in itself be entertaining, but the interest will become much intensified when these costs, as practically experienced in our own cities, are submitted in detail.

Many of our large communities are actually in the transition stage from a village to a city, and the demands of the citizens are generally largely in excess of the means which the legislative element of the local government places at the disposal of the executive element. As the latter seek to meet these growing public demands, by requesting annually, larger appropriations, or incurring greater expenditures than previously, the cry is heard on all sides that the municipal administration is either corrupt or else utterly inefficient; and as simple explanations are not accepted, it is necessary to resort to the popular system of explaining by comparison. By this process, the public becomes satisfied that the expenditures are not excessive, or that they should be increased, or that incompetency exists on the part of its officials; and as a result of the discussion, justice is done to a deserving officer, or the community improves its service by removing those who may be found corrupt or incompetent.

I therefore desire to call your attention to the question of the *maintenance* of municipal public works, and to express the hope that your contributors will, during the current year, bestow some consideration to that subject as well as to constructions and technical details.

Yours respectfully,
E. KUICHLING.

Hamilton, O., Water.

WATER WORKS OFFICE,
HAMILTON, O., JAN. 7, 1886.

EDITOR ENGINEERING NEWS:—I am seeking information regarding a matter, which, to the citizens of this city, is a very important one. Our "supply basin," "pipe system," and "Storage reservoir" have become infested with fresh water *Physa* (*P. heterostropha, Say*) to such an extent, that the use of "hydrant water" is being abandoned for house "purposes." The decayed animal matter produced by the dead *Physa*, seems to have impregnated every part of the system, and render the water very offensive. I am seeking the imformation of others (if there be any) who have had similar trouble, their mode of extermination, etc., and will be very grateful for any information on this subject. I will write full description of service here if deemed necessary, or will willingly give any information to any person willing to assist me in solving the problem.

Very respectfully,
T. E. CRIDER.

Ohio News.

Special Correspondence ENGINEERING NEWS.

URBANA, O., Jan. 11, 1886.

Tiffin, O., City Council are discussing plans of sewerage for that city.

Dr. Carl H. von Klein, of Dayton, Ohio, claims to have discovered a process for converting garbage and sewage matter into an odorless and clean fuel. He treats refuse, to disinfect and deodorize it, with salt, slacked lime and a little nitric acid to start the fumes, then, after eight days, with sal-soda. The composition will solidify in a few days, when it is pressed into bricks and dried until it is in a fit condition to be used. It produces a better flame, the inventor says, and retains more heat than Allegheny coal, and costs but little more than half as much as the cheapest other fuel in the market.

The following are sewer prices in Sprinfield, Ohio, from bids lately opened for the Foster street sewer: John L. Flynn, 2½ feet brick sewer, $2 for labor, $2 for material. 3 feet sewer, $2.50 each, labor and material. 12-inch sewer pipe, 50 cents each, labor and material; 24-inch pipe, $1 each. 6 inch slants to sewer, 25 cents each, labor and material; 18-inch slants, 40 cents, each part; 24-inch, $1 each. Catch basins each $25 for labor, $33 for material. Man holes, $10 each, labor and material. Rubble masonry, $1 labor, $3 material. Timber support, $2 for labor $22 matertal. Concrete, per cubic yard, $1 labor, $3 material. Total, $9,954.80.

Joseph Bolan, 2½ feet sewer, $1.10 for labor, $1.42 for material; 3 feet, $1.21 labor, $1.56 material; 12-inch sewer pipe, 25 cents labor, 75 cents material; 24-inch, 75 cents labor, $1.25 material; 6-inch slants, 10 cents labor, 15 cents material; 18 inch slants, 25 cents and $1.25; 24-inch, 75 cents and $2.25; catch basins, $18 labor, $30 material; man holes, $3 labor, $4 material; rubble masonry, $1.25 and $1.75; timber, $10 and $15; concrete, 10 and 90. Total, $5,455.40.

Ryan & Spellacy, 2½ feet sewer, $1.27 labor, $2.44 material; 3 feet 96 cents and $1.91. 12-inch pipe 19 cents and 58 cents; 24-inch, 38 cents and $1.14. 6-inch slants, 8 cents and 25 cents; 18-inch, 71 cents and $2.14; 24-inch, $1.11 and $3.33. Catch basins, $15.45 and $30. Man holes, $3.61 and $7.21. Masonry, $1.27 and $2.54. Timber, $5 and $10 24. Concrete, $3 and $10. Total, $5,568.99.

D. F. Minahan (lowest bid and knocks the persimmons) 2½ feet sewer, $1 each, labor and material; 3 feet ditto, 75 cents and $2. 12-inch pipe, 25 cents and 30 cents; 24-inch, same. 6-inch slants 10 cents and 20 cents; 18-inch, $1, each; 24-inch, $2 and $3. Catch basins, $20 and $30. Man holes, $20 each. Rubble masonry, $3 and $2. Timber, $2 and $8. Concrete, $30 and $10. Total, $5,117.

Ohio is being perforated everywhere for natural gas. A list of wells being bored is too great to attempt.

The work of constructing the Zanesville and Ohio River Railway, otherwise known as the "Black Diamond Ry." has begun, and will be pushed forward rapidly. The masonry contract was awarded to T. B. Townsend.

Prospectors are examining the proposed lines of the Toledo, Columbus, and Southwestern Railroad, and it is probable that the road will be constructed during the year.

The Toledo, Cincinnati and St. Louis Railroad (narrow gauge) was sold December, 30th, under foreclosure of mortgage, to Sylvester H. Kneeland of New York, for $1,501,000.

The miners and operators in the Hocking Valley coal region have submitted their differences to Judge Thurman, and his decision is looked for at an early date.

The Commissioners of Seneca county have determined to build a new jail at Tiffin, Ohio. The plans which have been partially agreed upon involve an outlay of $30,000.

There is some fear that Ohio will lose control of her canals this winter. An effort, it appears, will be made by the Standard Oil Company to get possession of them. During the past year the expenditures were $100,000 more than the receipts, yet there is a balance of $72,000 on hand. The new Board of Public Works think that by proper management they can be made to yield a good income.

Illinois and Indiana News.

Special Correspondence ENGINEERING NEWS.

CHAMPAIGN, Ill., January, 11, 1886.

The County Commissioners of Vigo county, Ind., have engaged a bridge expert to prepare plans for rebuilding the draw-span over the Wabash river at Terre Haute, to replace the one lately condemned by the U. S. Engineers. Directing the removal of obstructing bridges is in anticipation of the opening of the Wabash for navigation. The new locks at the rapids, forty miles below Vincennes, will soon be completed, which will open the river as far as Terre Haute.

The Vincennes, Ind., City Council have granted the right of way through the streets and alleys for the construction of an electric light and power company. It is the intention to light the town by electricity by the first of May next.

The Crawfordsville (Ind.) *Review* complains bitterly because the company has not commenced the construction of the proposed water works, the thirty days limit having expired with no signs of activity.

In the year 1885, there were sixty-one miles of new railroad constructed on four new lines in Indiana.

Articles of incorporation have recently been filed for building a railroad between Chester and Centralia, Ills.

The Drainage Commissioners of Union Drainage District, Ford county, Ills., will receive proposals till February 1, 1886, for the construction of about twenty-nine miles of large open ditches, aggregating about 357,000 yards of excavation. Plans, specifications and profiles can be seen at the office of M. R. Munts, clerk of the district, at Ashkum, Iroquois county, Ills.

The proposal of local capitalists to construct water works for Kankakee, Ills., seems to be off. That city is anxiously looking for some company who will give them a system of water works.

The Illinois State Board of Agriculture are making arrangements for a public trial of ditching machinery, and propose to offer two gold medals, one for the best apparatus for excavating large drainage canals, and another for the best machine for opening a ditch suitable for tile.

The annual report of the Illinois Railroad Commissioners for the year ending June 30, 1885, is just out, and is much more complete than in former years. Only

twenty-three miles of road have been constructed during the year, mere fragmentary bits near Chicago and East St. Louis. Illinois leads all other states in railroad mileage, there being 9,204; the states with the next greatest mileage are, in order, Iowa, Pennsylvania, New York and Ohio, each having in round numbers about 7,400 miles of main line and branches. The aggregate of stocks, bonds, and floating debt is $1,454,000,000. The cost of construction and equipment is reported at $1,369,000,000, or $61,900 per mile. If this is true it is exceedingly expensive. The items relating to the actual cost of construction and equipment seem to be about the most difficult to ascertain with any degree of correctness, so that an accurate statement of the aggregate is very difficult to give. The total operating expenses and taxes paid in Illinois during the year was $37,300,000, and the aggregate gross profits on Illinois business was $19,600,000. The balance applicable to dividends was $27,950,000, as against $31,350,000 the year before. The list of casualities shows that there were 369 employes killed and 1,094 injured.

The following is the cost of draining ninety acres of land:

	Per mile.
5,647 3-inch tile at	$ 10.00
3,437 3½-inch tile at	13.00
4,211 4-inch tile at	15.00
2,110 5-inch tile at	22.00
788 6-inch tile at	30.00
1,137 7-inch tile at	40.00
368 8-inch tile at	50.00
Branches	$299.45
Paid for 1,074 rods at 25 cents per rod for tiling	268.50
Paid for extra depth over three feet	17.70
Hauling tile one mile from works	15.00
Filling ditches after tiler	8.50
Total	$609.15

G. C. Harvey, County Surveyor, Wabash Co., Ills., writes that business was good with him last year; among other jobs he had charge of $55,000 worth of drainage work.

Indianapolis is to have a new union depot to cost $1,000,000. It is said that Indianapolis was the first city in the U. S. to have a union depot.

The Commissioners of Washington county, Ind., are taking steps to build a new court house.

Official figures show the daily consumption of water in Chicago to be in excess of 91,000,000 gallons, an increase of one-seventh over last year.

A party of Paris, Ills., officials are inspecting electric light plants preparatory to securing a system for that place. It looks as though electricity would do for gas and kerosene, what they did several years ago for the tallow dip.

The narrow (3 ft.) gauge railroad from Toledo to St Louis was sold to its bondholders recently; it is said that it will be changed to a standard gauge.

A large and enthusiastic meeting was held in Dubuque, Iowa, January 7th, to take action for the construction of a wagon bridge across the Mississippi at that place for the accommodation of the people of Illinois and Wisconsin who desire to trade on the other side of the river.

Corporation privileges have been conferred upon the Western Cable Motor and Construction Company, at East St. Louis, by a license issued by the Secretary of State to construct street and bridge railways, cable motors, and tubings and machinery for the manufacture of the same. The capital stock of the company is $500,000, and the incorporators are R. D. Hunter, Edgar L. Marston, William Hacker, Henry Pennington, Joseph R. Carpenter, and Zaccur P. Boyers.

O'Neal Brothers have announced that they will spend $30,000 in opening a coal shaft at Barnes, McLean county, Ills.

Dean Bros., Indianapolis, Ind., have the contract for the new pumping engine for the water works at Charleston, Ills.

Dominion News.

OTTAWA, Jan. 11th, 1886.

Special Correspondence Engineering News.

The Directors of the Brockville, Westport and Sault St. Marie Railway closed on the 6th inst. a contract with Robert G. Harvey for the construction and equipment of their line. The division, from Brockville to Westport, 50 miles, is to be completed by the 10th of Jan., 1887. The first sod is to be turned at Newton to-day. When the whole line is completed it will make the shortest line between the Northern Pacific and New York, and the New England States, to complete the connection with which it is intended, at no distant day, to bridge the St. Lawrence at Brockville. Mr. Harvey is well-known in connection with railway building in Illinois and Indiana, and is well qualified to carry out what he has undertaken.

Notices are given of application to Parliament to incorporate companies to build the following railways: the Columbia Valley Railway, to run from the west crossing of the Columbia river, B. C., on the Canadian Pacific, to the Gold river, and up the valley of that river to its source in the Kootenay district; for a railroad from Belleville, Ont., to James Bay, and for a railroad from Oxford, N. S., or a point on the Inter-Colonial between Oxford and Moncton, to Sidney and Louisbourg.

The Qu'Appelle, Long Lake and Saskatchewan Railway and Navigation Co. gives notice also of application for an amendment to its charter, to enable it to build a branch from a point on their line to Prince Albert, and to extend the line southward from Regina to Wood Mountain and the Souris Coal fields,—also to limit the power to issue bonds to $10,000 per mile, and to change the name of the company.

The Napanee, Tamworth & Quebec Railway intend to apply for power to build a line from Tamworth to some point on the C. P. R. at or near Tweed, and northwards to a point on the Central Ontario Railway.

The Department of Railways and Canals is preparing a splendid map of the Dominion, 12 feet by 14, which will accompany the Dominion exhibit to the Colonial and Indian Exhibition. It will show the complete route of the Canadian Pacific Railway and will give more accurate information than any map yet published.

The Montgomery, Ala., Water Works.

MONTGOMERY, ALA., Jan. 6th, 1886.

Special Correspondence ENGINEERING NEWS.

As your valuable paper contained, some weeks ago, an advertisement signed by W. S. Reese, Mayor, asking for proposals to furnish this city with water, it may be interesting to your many readers to learn the principal facts relating to the present and proposed systems of water supply.

In 1871 the State Legislature granted a charter to the Montgomery Water Works Company to supply this city with water for a term of 25 years, or until its charter might be forfeited.

In 1873 the city made a contract with this company to furnish the city and its citizens with "*an abundant supply of good water*," "during the term limited by the charter of said company," and expressly reserving the right to contract for water with any other party whenever the interests of the city might, in their opinion, require it. Upon the passage of this ordinance the company proceeded to build a system of works, similar to too many others that have been built in this country, small, cheap in both design and execution and in no way suitable to supply the city. The supply was taken directly from the Alabama river, without the aid of either filterers or screens, and for at least nine months in each year the water is not fit for use. The pumping machinery consisted of one small, duplex, high pressure Worthington pump, placed in the bottom of a deep well and supplied with steam from a battery of boilers above them.

The pump was never built to perform the work that it was called upon to do, and was handicapped by the most unscientific steam and exhaust piping imaginable. Leading from this pumping station to the reservoir there was a pipe 10 inches in diameter; connected with this were other pipes, aggregating about 10 miles in length, of which about 33 per cent. were 3 inches, 50 per cent. 4 inches and the remainder 6 and 8 inches in diameter. These pipes were laid without regard to promoting circulation or to avoid dead ends.

The reservoir was well enough in its way, but was located so low that many of the residences could obtain no water, and a majority of those who could get any, found it of but little use, owing to insufficient head.

With this "plant" the company started to do business, only to meet the difficulties which might be supposed. Complaints were numerous, both from citizens and from the fire department, the latter never obtaining a sufficient supply.

The natural result soon came, and in a few years the property and business of the company was closed out in the Chancery Court, and its charter became void with the death of the company and its contract with the city terminated by limitation.

The property was bought by a few parties who formed a new company under the name of the "Montgomery Water Works," and they attempted to continue the business under various temporary arrangements with the city, in lieu of a contract. Instead of profiting by the experience of their predecessors, they continued to operate the old plant without change or improvement. Instead of rebuilding, improving and making good, they contented themselves with merely patching and bolstering along the old works, and with about the same result. They satisfied no one, complaints were more frequent than ever, and notices from the City Council to the company, calling upon them to remedy the trouble, were of almost daily occurrence, but they were entirely disregarded by the Water Company, and no steps were taken to better the condition of affairs. Their one small pump became worn out by constant overwork, by continual pumping of the gritty river water. The capacity of their pipes was less and less able to supply the demand, more and more people were unable to obtain any water, and their reservoir gradually filled up with filthy sediment, the slopes were covered with slime and the waters were filled with fish.

After bearing with the abominable state of things until the people cried out, as with one voice, against it, the City Council authorized the Mayor to advertise for proposals to furnish the city with an abundant supply of pure water.

After receiving visits from nearly all of the leading hydraulic engineers in the country and carefully considering their various plans, the City Council adopted the plans submitted by Arthur H. Howland, of Boston, Mass., as being best suited to their needs, and entered into a contract with him for furnishing the city with water for all purposes.

Under the terms of this contract the work is now being executed. The supply is to be taken from artesian wells, collected in a reservoir of 3,000,000 gallons capacity, and from there pumped through the pipe system to a stand-pipe 250 feet above high water mark. This will give a pressure of 95 pounds through the business part of the city, and 43 pounds on the highest residence portion.

The pumping machinery will consist of one compound condensing engine and one high pressure, each of a possible maximum capacity of 4,000,000 gallons in 24 hours. The boilers will consist of six 80 horse power steel boilers, set in two batteries. The entire pumping machinery is being built by the Deane Steam Pump Company, of Holyoke, Mass. The pumping station is to be of brick with an iron truss roof, fitted up with all possible facilities for economical and efficient operation. The distribution system will consist of 20 miles of cast-iron pipe, of from 24 to 6 inches in diameter, with about 7 miles of 4inch circulation pipes. The larger pipes are being furnished by the Warren Foundry and Machine Company of Phillipsburg, N. J., and the smaller ones by the Chattanooga Foundry and Pipe Works of Chattanooga, Tenn. On this will be located 200 hydrants and 254 gates. All of these are being made by the Coffin Valve Company, of Boston, Mass. The stand pipe will be 26 feet in diameter and 105 feet high above the foundation; it will be encircled by a spiral stairway extending to a balcony at the top. The whole having an ornamental hand rail and balustrade, which, when completed, will form one of the finest observatories in the State, and be one of the many attractions to the city.

The work of construction is being rapidly pushed in all departments, and before many weeks our citizens will be able to obtain an abundant supply of pure water, something they have never known, and something which they can appreciate the more, for reason of having been so grievously disappointed in the past. A.

WATER

THE Pensacola, Fla., Water Co., capital stock $150,000, has been incorporated with B. R. Pitt as President.

TEN thousand acres of land have been leased by Pittsburg capitalists for natural gas wells in the neighborhood of Boliver, about twenty miles west of Johnstown, Penna.

ALBANY, Jan. 4.—Mayor Banks who vetoed the ordinance for driven wells, as mentioned in this journal last week objects to the resolution because the bidders are limited by it to William B. Andrews & Brother of Brooklyn, and on account of the short guarantee of sixty days required of the contractors. He thinks that the questions of the best available water supply, and the means of securing it have not yet been satisfactorily solved and recommends an appeal to the Legislature to continue the present special commission, so as to give it an opportunity for further investigation before the matter is settled.

THE City Council of Palatka, Florida, have passed an ordinance granting to Charles Underwood and others, the right to construct water works in that place.

The supply is to be drawn from the White water branch, one mile distant. The pumps will have a capacity of 1,000,000 gallons daily, delivered in a stand-pipe 126 feet high, and 25 feet in diameter.

There will be 26,000 feet of mains, ranging from 6 to 12 inches in diameter.

At least 40 double nozzle hydrants will be furnished, for which the city will pay $50 each per annum.

Rates for metered water will be 20 to 40 cts. per 1,000 gallons, according to quantity furnished.

The city reserves the right to purchase the works after ten years, at the price named by three appraisers, one to be chosen by the City Council, one by the owners, and the third by the other two.

The works are to be begun within 2 months and finished within 7 months from date of ordinance—Dec. 29th, 1885.

Water Pressure in Mains of Various Cities.

COMPILED BY J. J. R. CROES. FROM SPECIAL RETURNS, DEC. 1885.

Town and State.	Topography.	Difference of level in town.	In Business District.		Fire Pressure.
			Day Pressure.	Night Pressure.	
		feet.	lbs.	lbs.	lbs.
Alpena, Mich.	level.	0	20	18	80
Atlantic, Ia.	hilly.	100	75	——	90 to 120
Austin, Tex.	hilly.	——	50 to 60	50 to 60	120 to 160
Bangor, Me.	hilly.	50 to 200	110	110	110
Bay City, Mich.	level.	0	25	30	60
Bayonne City, N. J.	hilly.	5 to 34	45 to 55	55 to 60	45 to 60
Beaver Falls, Pa.	hilly.	50	70 to 75	75 to 80	110
Bellaire, Ohio.	hilly.	——	65	80	65
Belleville, Ill.	hilly.	40	65 to 70	65 to 70	125 to 130
Beloit, Wis.	hilly.	20 to 40	110	50	100 to 150
Berwick, Pa.	level.	0	27	27	27
Bethel, Ct.	nearly level.	——	60 to 75	60 to 75	60 to 75
Binghamton, N. Y.	nearly level.	20 to 30	40 to 45	50	60 to 70
Birmingham, Ct.	hilly.	60	70	70	90
Bloomington, Ill.	almost level.	50	75	75	75 to 150
Bloomsbury, Pa.	level.	0	75	80	150
Boonville, Mo.	hilly.	40 to 50	40	40	65
Bordentown, N. J.	level.	0	33	——	100
Boston, Mass.	hilly.	——	35	37 to 38	——
Bowling Green, Ky.	level.	——	80	——	——
Bradford, Pa.	hilly.	200	95	95	95
Brandon, Vt.	hilly.	0	65	——	65
Brantford, Ont.	level.	——	50 to 75	70 to 80	70 to 80
Brazil, Ind.	nearly level.	——	60	20	85
Bridgeport, Ct.	nearly level.	25	20	35	20

The village of St. Joseph de Levis, Quebec, will be supplied with water next spring from the vicinity of the Engineers' camp by means of wooden pipes.

The contract for furnishing pipes and castings for the Boston water works has been awarded to R. D. Wood & Co., 400 Chestnut street, Philadelphia, at $29.40 per ton of 2,240 pounds.

The Dyer well, near Washington, Pa., is reported as flowing at the rate of 150 to 200 barrels per day. This opens a large tract of new petroleum territory.

J. J. Speedling of Newark, N. J., has purchased Caryl Lake, 400 feet above Worcester, N. Y., and covering 45 acres. He will commence arrangements for bringing a water supply to the village from the lake.

The Fulton and Oswego Falls, N. Y., water works were successfully tested on the 30th ult. Seven streams were simultaneously thrown,—four in Fulton and three in Oswego Falls, each through 200 feet of hose with a one-inch nozzle. For two hours the water gauge showed a pressure of eighty pounds. Everybody was happy and pleased. The Presidents and Trustees of both villages express themselves as very much pleased at the result of the test, which surpassed the requirements. At the annual rate to the village, $50 hydrant, this additional fire protection greatly lessens the rate of insurance. One large milling firm declare that the assessment saved to them alone will equal the cost to the entire village. A large number of houses have already been furnished with water. It is so soft as to take the place of rain water in all its uses, and is unsurpassed for drinking purposes. The officers of the Fulton Water Works Company are John W. Pratt, President, Willard Johnson, Vice President, H. E. Nichols, Treasurer, Giles S. Piper, Secretary; Executive committee, A. G. Gilbert, H. E. Nichols and Fred. Emerick.

The works were built by Messrs. Hinds, Moffett & Co. of Watertown, N. Y. The machinery was furnished by Henry R. Worthington of this city. There are eight miles of mains, with thirty-four hydrants. Full particulars will be given by Mr. Croes in "History and Statistics of American Water Works" as soon as they can be obtained.

The official test of the Mexico, Mo., Water Works was made on the 4th, and was a "complete success." The contract called for six streams through 50 feet of 2½-hose, one inch ring nozzle to a height of 80 feet vertical; they were thrown from 166 feet to 140 feet vertical, the best done afterwards with a test stream being 206 horizontal, equal to 165 feet vertical.

The machinery is composed of two Blake duplex pumps; one for domestic service of the capacity of 720 000 gallons per twenty-four hours, and one for fire service of 1,250,000 gallons per twenty-four hours, working against a head of 75 pounds and 130 pounds respectively. The boilers, each of 50-horse power, and all the other appliances were furnished by the Pond Engineering Company of St. Louis, and the whole plant is of the latest and most improved style and character. The hydrants and valves were furnished by the agents of the Chapman Valve Company, Messrs. Ripley & Kimball, St. Louis, and the cast iron mains by the Shickle, Harrison & Howard Iron Company, of St. Louis. The reservoir, containing when full, over 50,000,000 gallons of water, has been nearly filled by the recent slight rains, demonstrating the correctness of the figures on which the water supply was based.

City Engineer Rodgers made a report to the council that he had examined and measured the entire system of water works and found that the ordinance had been complied with by the contractors in every particular. The city Council in session Wednesday morning adopted the above report of the engineer.

Messrs. Morris R. Locke & Co., builders of the Moberly, Mo., water works, were the contractors, Mr. W. C. Masten being their superintendent of construction. The new superintendent of the works is Chas. A Masten, of St. Charles. We extract the following notice from the Mexico *Ledger* of the 7th:

"Springfield, Ill., Dec. 30.—An incorporated license was issued to-day by the Secretary of State for the City Water Company, at East St. Louis; capital stock, $250,000; incorporators: Charlie Thaw, Frank H. Pond, of St. Louis, and Cornelius S. Masten, of Moberly.

"This is the same company that put in the Mexico and Moberly water works. They have a contract also for Chillicothe. They know their business, and knowing, do it well. They richly deserve the enviable reputation they have."

NEWS OF THE WEEK.

Railroads, Bridges and Canals.

Woolsey & Bismarck R. R.—Articles of incorporation have been filed with the Secretary of Dakota Territory for a new railroad to be constructed from Woolsey, Dak., to Bismarck. This will connect the Milwaukee & St. Paul and the Northern Pacific systems.

Milwaukee and St. Paul Extension.—Surveyors of the Milwaukee & St. Paul R. R. have been detailed by the company to select a feasible route from Bismarck, Dakota, to Buford, and if no unforseen obstacle presents itself the survey will be made at an early date.

The Newport News and Mississippi Valley R. R. is the name of a new company which will be the consolidation of the various roads of the Hungtington system east of the Mississippi.

New Railroad.—A new railroad is proposed from Bay City direct to Chicago by way of Ithaca, Ionia, Allegan, and Benton Harbor, making the distance only 226 miles. The scheme is to extend it via Cairo to Port Huron, which would reduce the distance from Cairo to Chicago to 256 miles.

Removing Debris from the Face of a Tunnel.—A method has just been patented for removing the debris after a blast. Greased planks are laid longitudinally to act as rails for a plank platform the whole width of the cut. This platform is pushed up to the face before the blast is fired, after which the whole or a portion of it is drawn out with the dirt piled on it.

The Pittsburg and Preston County Railroad Company has been incorporated to build a railroad from the Pennsylvania State line in Preston county, down Big Sandy Creek to Clifton Mills, and from thence in a southeasterly direction to a point on the Baltimore & Ohio Railroad east of the Cheat river and west of the Maryland State line in the county of Preston. The capital stock is $100,000.

The Denison and Wichita Valley Railway Company has been incorporated; capital, $020,000. John Scullin, of St. Louis, and others, of Denison, are the incorporators. The road is to run from Denison, Tex., to a point on Red River, opposite the mouth of the Wichita, in the Indian Territory; also, from Denison to another point on Red River, west of the mouth of Choctaw Boyou, all with privilege of extension through the Indian Territory.

Scotland, Bismark, & Northern R. R.—The line of the proposed road is from Scotland in a northwesterly direction, through Hutchinson, Douglass and Aurora, forming a junction with the Chicago, Milwaukee & St. Paul R. R., at Plankington, from thence to Duncan, Buffalo county and bearing off in a northwesterly direction, will cross the Winnebago reservation to the Medicine Creek valley, and follow the valley to Holabird, and there form a junction with the Northwestern Railroad.

Colorado's Railroads.—The railway system of Colorado, according to the returns of the State Census Commissioner, comprises 3,072.34 miles, divided among sixteen roads—nine broad-gauge and seven narrow-gauge roads. The standard gauge roads have a mileage of 1,320.30, and the narrow-gauge 1,752.04. The aggregate of funded debt represented by the several companies is $137,427,285, and the total interest paid since its accumulation is $6,552,586.69, while the total assets of the roads, including the cost of construction, is $376,169,353.45. The average number of employes on the railroads of Colorado is nearly 13,000.

The Long Island Port Scheme Again.—The survey for the extension of the Long Island Railroad system from Bridgehampton to Fort Pond Bay, a distance of thirty-five miles, has been completed, and a plan of docks to be laid out at the latter place has been made in anticipation of favorable action being taken by Congress on the bill recently introduced by Congressman Perry Belmont, intended to give American registry to vessels of the American Steamship Express Company. Should the bill become law, work on the extension and docks would at once be begun in readiness for the docking of ocean steamers and the carriage of passengers by them to and from New York.

Work Commenced.—Bloomsfield, Pa., Jan. 5.—The first pick was struck this morning on the new railroad from Milton, Northumberland county, to Millville, Columbia county. The road is a private enterprise, being built principally by Milton capital. It will be twenty-three miles long. Surveyors are running a line for another road in the same district. This rival scheme is under the direction of Rev. Dr. Walker, President of the Northwest Branch Railroad, who some years ago in connection with William Neal of Bloomsburg; Hon. H. W. Palmer, of Wilkesbarre; Colonel Jamison, of Philadelphia, and other capitalists secured a charter for the Bloomsburg and Sullivan Railroad.

Chesapeake & Nashville R. R.—R. L. Williams, C. E., informs us that a location party is to be put in the field at once on the above railroad, to locate from Scottsville, Ky., to Glasgow, Ky., twenty-five miles. Glasgow has offered $50,000 and right of way. Work will be commenced on this section in the early spring. Work is being pushed between Gallatin and Scottsville; track will be laid by March 1st. A branch is to be built at once from Gallatin to the Cumberland River to obtain material. Nashville has at last given the right of way through the city, and her subscription to right of way through Davidson county, and as soon as the 5 per cent. of her quota of $500,000 is paid, the work between Gallatin and Nashville will be commenced. It is rumored that surveys will be made from Gallatin south to the Tennessee River.

Market Report of Engineering Materials.

New York, January 14, 1886.

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

IRON.

STRUCTURAL IRON.			
Angles	1.95	@	2.00
Tee	2.25	@	2.35
Beams and channels American	3.0c.	@	
Tank	2.	@	2.1c
Shell	2.4c.	@	2.5c
Steel plates, Tank	2¼c.	@	
WROUGHT-IRON PIPE., PITTSBURGH.			
Butt welded, black ..Discount	42½	@	45
" " galvanized "	32½	@	35
Lap welded black "	60	@	62½
" Galvanized "	45	@	42½
Boiler tubes "	55		
RAILS.			
Steel (large lots at mill)	34.00	@	35.00
Old rails	24.25		
Old rail steel	22.00	@	23.00
R R. spikes	2.25c.		
R R. splice-plates	1.70	@	1.75
R R. Track Bolts Square Nuts	2.75		
Barb-wire fencing, galvanized			4.75
" " painted			3.75
Corrugated iron			
Nails			
Iron, per keg	2.65	@	2.75
Steel do.	2.50		

METALS.

COPPER.			
Lake Superior	11.45	@	11.70
Other Brands	10.35	@	10.50
LEAD.			
Com. Domestic	4.65		4.67½
Lead Pipe	.06¼		
Tin-Lined Lead Pipe	.15		
Sheet Lead	.07¼		
ZINC.			
Sheet	5.15	@	5.45

BRICK.

Cargoes afloat)			
Haverstraw per M.	$7.25	@	7.50
Fishkill			
Up-River			
Jerseys	6.50	@	7.00
Long Island			
" pale	3.50	@	4.00
FRONTS.			
Croton, red	11.00	@	14.00
" dark	11.00	@	14.00
" brown	10.00	@	13.00
Philadelphia pressed	24.00	@	25.00
Trenton "	24.00	@	25.00
Baltimore "	37.00	@	41.00
Buff "	33.00	@	35.00
Enameled English	65.00	@	130.00
" American	85.00	@	120.00
Fire brick	24.50	@	55.00

CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

Alsen's Portland Cement Works	$2.50	@	$3.00
BAETJER & MEYERSTEIN:			
Hanover Portland	2.60	@	2.65
BELLONI & CO.:			
Hemmoor "Crown" brand			2.50
JAMES BRAND:			
K. B. & S	2.55	@	3.00
BROOKS, SHOOBRIDGE & CO.,	2.45	@	2.60
HOWARD FLEMING:			
Gibbs' English Portland, 400 lbs.	2.65	@	2.90
K. B. & S. "	2.75	@	2.95
Stettiner, German	2.65	@	2.85
Lagerdorfer, "	2.45	@	2.75
Fievc. A 1, Belgian	2.35	@	2.50
Roman	2.75	@	3.00
Keene's Coarse	4.75	@	5.50
" Fine	7.75	@	8.50
" Superfine	8.50	@	10.00
FISHER, ERSKINE W.:			
Stettin (German) Portland Cement	$2.40	@	2.75
GABRIEL & SCHALL:			
Vorwohler "Lion"	2.65	@	3.10
HUDSON RIVER CEMENT CO. Rosendale			1. 0
JOHNSON & WILSON:			
Saylor's American Portland	2.15	@	2.40
LAWRENCE CEMENT CO.:			
Hoffman Rosendale			
LESLEY & TRINKLE, Philadelphia, Pa.:			
"Giant" Portland	2.20	@	2.40
Improved "Union"	1.25	@	1.50
Union	1.10	@	1.20
MARCIAL & CO.:			
J. B. White & Bros. Coarse	4.50	@	5.00
" Fine	8.00	@	10.00
" Portland	2.45	@	2.85
NEW YORK CEMENT CO.:			
Rosendale			1.30
N. Y. & ROSENDALE CEMENT CO.:			
Rosendale, "Bridge" brand			1.10
SINCLAIR & BABSON:			
K. B. & S	2.35	@	2.60
STANDARD CEMENT CO,			
E. THIELE:			
Dyckerhoff	2.90	@	3.25
UNITED STATES CEMENT CO.:			
Windsor	1.00	@	1.10
Standard			1.15
Cable's Portland	2.15	@	2.40
UNION AKRON CEMENT CO.:			
Akron "Star" brand,			

ASPHALT.

Prices range per ton	$15.00	@	20.00
According to quantity or brand, and whether taken from vessel or store.			

LIME.

Rockland, common per bbl	1.00		
" finishing	1.20		
State, common	.90		
" finishing	1.10		
Kingston, ground	95	@	1.00
Add 25c. to above figures for yard rates.			

STONE.

Cargo rates at New York.

Amherst freestone, No. 1 per cub. ft.	0.95	@	1.00
" " No. 2 "	0.75	@	0.85
" " light drab "	0.80	@	0.95
Berlin " in rough "	0.75	@	1.00
Berea " "			
Brown stone, Portland, Ct. "	1.00	@	1.35
" Belleville, N. J. "	1.00	@	1.35
Granite, rough	0.45	@	1.25
Common building stone per load	2.00	@	3.00
Base stone, from 2½ to 6 ft. lengths, per lin. ft.	0.40	@	3.00

SLATE.

Purple roofing per square	6.00	@	7.00
Green "	6.00	@	7.00
Red "	15.00		
Black Penna. (at New York) "	4.50	@	5.00

LUMBER.

Prices for yard delivery in New York.

PINE, Common box per M.	18.00	@	20.00
" Choice "	65.00	@	70.00
Tally plank, 1¼ in. 10 in. dres'd, each.	.44	@	.50
Tally boards, dressed com. "	.28	@	.30
SPRUCE, Boards dressed "	.25	@	.28
Plank, 1¼ in "	.28	@	.30
" 2 in. "	.38	@	.40
" 2 in. dressed "	.43	@	.45
Timber per M.	20.00	@	22.00
HEMLOCK, Boards each.	.18	@	.20
Joist, 2½ × 4 to 4 × 6 in	.16	@	.41
OAK per M.	55.00	@	65.00
CYPRESS 1, 1¼, 2 and 2½ in "	35.00	@	40.00
YELLOW PINE, Girders "	25.00	@	30.00
Dressed flooring "	28.00	@	35.00
SHINGLES, Extra shaved pine, 16in. "			
" sawed 18 in. "	5.75	@	6.00
LATH, Cargo rate "	2 25	@	2.30

PAINT.

Lead, white, American dry per lb	.04½	@	.06
" " in oil pure "	.06½		
English, B. B. in oil "	.08¼	@	.08¾
Red, American "	.05¼	@	.05½
Litharge "	.05	@	05½
Venetian red, American "	.01	@	.01¼
Indian red "	.05	@	.10
Vermillion, American lead "	.10½	@	.12½
Paris green "	.15	@	.20
Umber, Amer. raw and powdered per lb.	.01¼	@	.01¾
Drop black, Amer. "	.07	@	.13
" " Eng "	.11	@	.13
Chrome green	.05	@	20
Oxide zinc, American	.03¾	@	.04
" French	.06	@	.08

Trade Notes.

THE contract for erecting a county jail at Palatka, Fla., has been let to John D Fred, of Macon, Ga., at $12,640.

THE contract for building a railroad from Jacksonville, Fla., to Millen, Ga., has been let to M. T. Dill.

MEXICO, Mo., must have a new bridge over the railroad. It will cost $8,000. The C. & A. R. R. very liberally offers $2 000 and furnishes the plans, etc., which are very costly. Now if the Wabash will give $2 000, Mexico will only have to pay $4,000 for a good iron bridge.—Ledger.

THE Atlanta Bridge & Iron Works has been chartered at Atlanta, Ga., with W. R. Tuttle, of Knoxville, Tenn., president, and J. C. Kirkpatrick, secretary and treasurer. This is a reorganization by the creditors of the Atlanta Bridge Works.

THE following is a table of average prices of No. 1 foundry in Ohio markets, in the years quoted:

	1885.	1878.		1885.	1878.
January	$17.70	$20.00	August	$16.50	$18 00
February	17 50	19 50	September	16.50	18 00
March	17 25	19.25	October	16.50	17.75
April	17 25	18.75	November	17 00	18 00
May	17 50	18 00	December	18 00	18.25
June	17.25	17 75			
July	16.50	17.75	Average for year	17.12½	18.41⅔

These figures are valuable for preservation.

THE total number of pig-iron furnaces in blast on January 1, 1886 (Iron Age figures) was 275, with a weekly capacity of 91,814 tons, against 254 furnaces in blast on December 1, 1885, with a capacity of 84,966 tons weekly. This is an increase of 26 furnaces in blast during December, and an increased production amounting to nearly 7,000 tons weekly. Since October 1 there have been 29 anthracite furnaces blown in, with a capacity of 9,500 tons weekly. In the same quarter 26 bituminous furnaces, with a capacity of nearly 11,000 tons weekly, were blown in. The increased number of furnaces in blast, as compared with January 1, 1885, is 59.

PITTSBURG, Penn., Jan. 4.—There was a general resumption of work in the river coal mines to-day, at the reduced rate. A further reduction of wages is probable in the spring. Leading operators assert that during the four months of the strike Pittsburg lost her prestige in the lower markets, and can only regain it by underbidding all competitors. It is estimated that the 7,000 miners engaged in the strike, lost in wages nearly $2,000,0 . The loss to the operators in damage to tipples, rolling stock, barges, etc., by long idleness, cannot be estimated.

BELOW is given the cost of a ton of pig iron in the Birmingham (Ala.) district, with the cost of each material necessary to its production:

Iron ore, 2½ tons at $1	$ 2 33
Coke, 1½ tons at $2	3.00
Limestone, 1 ton at 70c	70
Labor and salaries	1.50
Repairs	1.50
Interest	1.00
Total	$ 10 01

This estimate, which is exceedingly liberal, is made for a furnace having a capacity of producing 100 tons of pig-iron per day.

THE figures below indicate the process made in Germany in the use of iron sleepers:

Year.	Wood sleepers.	To 1 kil.	Iron cross sleepers.	To 1 kil.	Iron ground plates
1880-1	56,906 300	1.001	1,418,241	1.083	3,298 19
1881-2	56,691 753	1 003	2 189,236	1.077	3 908.28
1882-3	56,669 541	1.004	3,781 100	1 081	4 225 00
1883-4	56,534,668	1,004	5,440,772	1,093	4,770 00

BIDS will be received for building a new court house at Calhoun, Ga.

THE city of Buffalo's indebtedness on Jan. 1 was $8,050,735 93, and its resources over liabilities $1,935,134.41. The credit of the city is first class. Taxation to the amount of 2 31 per cent. on the valuation of property is believed to be excessive to such an extent as to depress the business interests of the city and to drive away business and manufacturing enterprises requiring the investment of large capital and the employment of labor. A reduction in the rate is recommended.

An English Engineering Trades' Report.

MATHESON & GRANT, London agents for the purchase of machinery and engineering material, in their half-yearly report, dated Jan. 1, 1886, speak as follows of the prospects for 1886 from an English standpoint:

IRON.—The past year has been probably the worst ever experienced as far as prices and profits are concerned, and about one-third of the furnaces of the United Kingdom are out of blast. Scotch iron, which recovered slightly in July, is again lower than in Jan. 1885, and pig-iron at Middlesboro', which one year ago was 25s., is now below 22s., a rate which allows no real profit. The trade in rolled iron is even worse.

STEEL.—Prices for rails have remained about £4 15s to £5 during the year; but the works have been only half employed and very scant profits made. Slackness in ship-building has caused a falling off in the demand, as in 1885 48 per cent. of the tonnage launched on the Clyde was of steel. The use of the basic process for making steel from phosphoric ores does not seem to grow in England, and the output was only 145,000 tons, while in Germany and France 750,000 tons were so made in 1885. This is mainly due to the fact that in England the purer Barrow and Spanish ores are cheaper than on the Continent, and Bessemer steel, either by the acid or basic process, as at present made, does not command the complete confidence of engineers for structural purposes, steel made by the Siemens' and kindred processes being preferred.

SCRAP-IRON, during the last half-year, has fluctuated little, being about 43s. for heavy scrap and 53s. for old iron double-head rails f. o. b.

IRON AND STEEL SHIPBUILDING.—There is but slight recovery from the depression of one year ago. On the Clyde the vessels launched in 1885 amounted to 194 000 tons; while in 1884 the output was 297,000 tons, and in 1883 430,000 tons. The average annual tonnage launched on the Clyde alone for the 10 years ending 1882, was 242,000 tons. On the Tyne, 103 000 tons have been launched as against 124,000 in 1884; on the Wear, the output in 1885 was only 61,000 tons as against 100,000 tons in 1884, and 212,000 tons in 1883.

BRIDGE AND STRUCTURAL IRON WORK.—Bridge builders' prices are lower than ever, and they have little work. The principal features in this trade are the growing use of hydraulic riveting and forging, the more extended use of steel and more long-span bridges than formerly. The mains of the Hydraulic Power Co., of London, now offer facilities for riveting work "in situ," with better results and no noise. India has called for a continual export of bridges, and there is a demand in Australia; "but the attempts to manufacture in the Colonies can only succeed under protective tariff or other legislative interference."

LOCOMOTIVES AND RAILROAD MATERIAL.—Builders of locomotives have been fairly occupied at moderate prices. The leading makers are reducing force and the prospect is not bright. The substitution of metallic sleepers for wood seems likely to be applied to England; corrugated steel chair sleepers are supplanting the cast-iron pot-sleepers in India.

PORTLAND CEMENT trade is in a very depressed condition, factories are working short time.

PUBLIC WORKS are few in England, and there are fewer Private Bills for the coming year than usual. Foreign and Colonial works afford the best prospects for the engineering trades. The New Congo Railway will create a wide field for engineers; Northern Burmah is also now open, and needs railways and machinery; and China, "now forced to have railways as a part of her military defence, will soon see the advantages of them for other purposes." Brazil is struggling with the emancipation of the slaves and general depression; the Argentine Republic has by over-speculation and reckless expenditure caused a crisis and a great depreciation of the national currency. The Colonies and India are looked upon as the best and safest markets; but the English Parliament and people cannot control Colonial public works; they buy where they please, and "the Colonial Governments, having borrowed money in England for their railways, use the proceeds in buying the material in the United States, or from Continental makers, instead of from England, where any saving in price is apparent.